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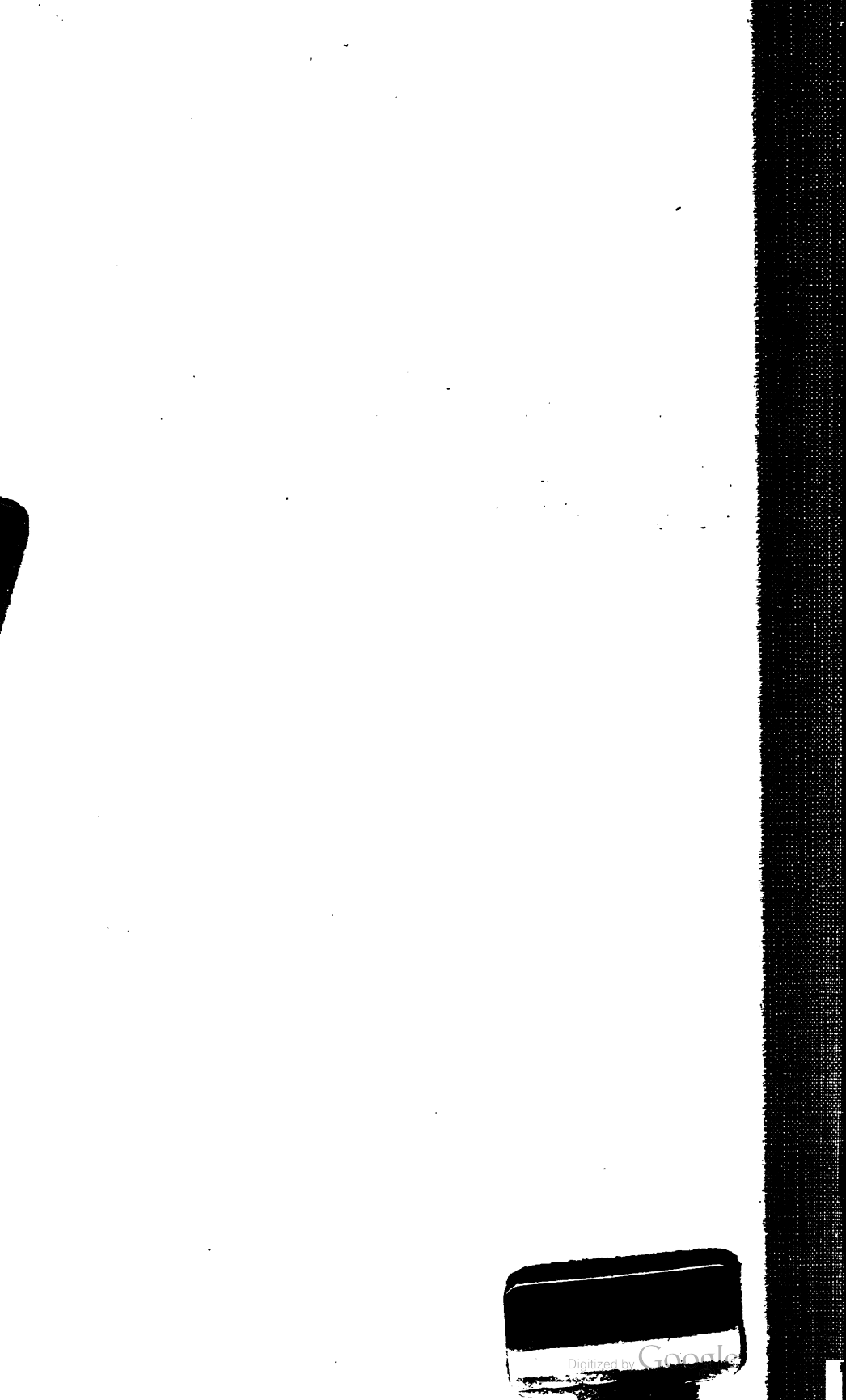
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ANNUAL REPORT

OF THE

COMMISSIONER OF FISHERIES

TO THE

SECRETARY OF COMMERCE

FOR THE

FISCAL YEAR ENDED JUNE 30, 1916

WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

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Bureau of Fisheries Document No. 836

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CONTENTS.

	Page.
General review	5
Propagation and distribution of food fishes	6
General extent and importance	6
Hatcheries operated	8
Pacific salmon culture	11
Propagation of migratory fishes of Atlantic streams	16
Fish culture in the Great Lakes	19
Operations of the inland hatcheries	24
Marine fish-cultural work	26
Rescue of fishes from overflowed lands	29
Acclimatization	30
Cooperation with the States	31
Fishes planted in connection with fish-cultural experimental work	32
Artificial propagation of fresh-water mussels	33
Marine and fresh-water investigations, surveys, and experiments	34
Studies of marine fishes	34
Shellfish investigations	35
Progress of diamond-back terrapin culture	37
Surveys of fishing grounds	38
Oceanographic studies	39
Studies of anadromous fishes	41
Investigations relating to fresh-water fishes	42
Service of biological laboratories	45
Miscellaneous investigations	48
Commercial fisheries	50
Fresh-water mussel fishery	50
Fisheries of Lake Pepin and Lake Cooper	58
Crab industry of Maryland and Virginia	60
Shad and alewife industry of Chesapeake Bay and tributaries	65
Coastal fisheries of New York and New Jersey	72
Shad fishery of the Hudson River	76
New England vessel fisheries	76
Pacific halibut and cod fisheries	96
Promotion of American caviar	97
Introduction of new aquatic foods	98
Alaska fisheries service	100
Extent of the Alaskan fisheries	100
Enforcement of law	101
Waters closed to commercial fishing	101
Commercial fishing within reservations	102
Salmon census in Wood River	102
Inspection of hatcheries	103
Alaska fishery legislation	103
Alaska fur-seal service	105
Seal herd	105
Seals taken for natives' food	106
Establishment of the fur-seal trade in America	106
Support of the natives	107
Blue foxes	107
Coast-guard patrol and the naval radio service	108
Minor fur-bearing animals of Alaska	108
Miscellaneous matters	110
New establishments and constructions	110
Movements, repairs, and construction of vessels	111
Publications	113
Appropriations	114

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REPORT

OF THE

COMMISSIONER OF FISHERIES.

DEPARTMENT OF COMMERCE,
BUREAU OF FISHERIES,
Washington, October 9, 1916.

SIR: There is submitted herewith a report giving an outline of the operations of the Bureau of Fisheries during the fiscal year ended June 30, 1916.

GENERAL REVIEW.

On February 9, 1916, the Bureau of Fisheries celebrated the forty-fifth anniversary of its establishment as a commission with purely investigatory functions. Public exercises were held in the auditorium of the National Museum, and the occasion was largely devoted to the dedication of a bronze memorial tablet to Spencer Fullerton Baird, the founder and first commissioner of the Bureau. The tablet was provided by the private subscriptions of persons now in the Bureau who were there under Prof. Baird; by persons who were officially associated with Prof. Baird in the fishery work but who are no longer connected with it; by a few who, while never in the regular fishery service, were closely connected with it in the days when Prof. Baird was Assistant Secretary and later Secretary of the Smithsonian Institution and Director of the National Museum as well as Commissioner of Fisheries; and by some persons who, in later years, have been officially engaged in some of the varied operations to which Prof. Baird gave impetus. The memorial contained a medallion portrait and the following inscription:

SPENCER FULLERTON BAIRD

1823–1887

FOUNDER AND ORGANIZER OF THE UNITED STATES BUREAU OF FISHERIES

Commissioner of Fisheries 1871–1887

He devoted his life to the public service and through the application of science to fish culture and the fisheries gave his country world-wide distinction

His coworkers and followers in this field dedicate this tablet on the anniversary of the establishment of the Federal fishery service

February 9, 1916

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The meeting was presided over by the Commissioner of Fisheries; an address on "Personal Reminiscences" was delivered by Dr. William H. Dall, author of a notable life of Prof. Baird; Prof. Edwin Linton, a special investigator for the Bureau under Prof. Baird and subsequent commissioners, spoke on "The Man of Science and the Public: An Appreciation of Spencer Fullerton Baird," and presented the memorial tablet to the Department of Commerce on behalf of the donors; Vinal N. Edwards, the senior employee of the Bureau, who had been associated with Prof. Baird at Woods Hole since the very inception of the service, unveiled the tablet; and Hon. Edwin F. Sweet, Assistant Secretary of Commerce, in an able address, accepted the tablet on behalf of the Department. The tablet was subsequently set in a conspicuous place in the wall of the building of the Bureau of Fisheries.

The Bureau long ago passed the critical period of its existence and became one of the great Federal instrumentalities for public good. During the last year its already highly varied functions, to which Congress has added from time to time, have been extended; new achievements of permanent importance in behalf of the fisheries, fishermen, and fish consumers are to be recorded; increased appreciation by the general public of the value of the work is to be noted; and plans for still further usefulness have been perfected.

The executive staff at headquarters at the beginning of the fiscal year consisted of H. F. Moore, Deputy Commissioner; Irving H. Dunlap, assistant in charge of office; Robert S. Johnson, assistant in charge of fish culture; Robert E. Coker, assistant in charge of inquiry respecting food fishes and the fishing grounds; Alvin B. Alexander, assistant in charge of statistics and methods of the fisheries; and Ward T. Bower, chief agent of the Alaska service. The Bureau suffered a severe loss by the death, on March 17, 1916, of Mr. Johnson, who had been chief of the fish-cultural work since 1909 and an efficient and loyal employee in that branch of the service since 1881. He was succeeded by Henry O'Malley, who has been an employee in the division of fish culture since 1897 and field superintendent in charge of Pacific-coast operations since 1913. No other change among the administrative staff occurred during the year. To the foregoing officers, to superintendents and directors of stations and laboratories, to the captains of vessels, and cars, to the agents in charge of remote seal islands, and to the great body of subordinates of all capacities on land and sea through whom the real work of the Bureau is accomplished the Commissioner desires to express thanks and commendation for arduous duties faithfully performed, which made the fiscal year 1916 the most noteworthy in the history of the Federal fishery service.

THE PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

GENERAL EXTENT AND IMPORTANCE.

Continued progress has been made in fish culture, and the fiscal year 1916 was in general the most successful in the Bureau's history. The distribution of fish and fish eggs shows an increase of 558,504,762 over the preceding year and reached the enormous total of 4,847,262,566. Large increases over the previous year were effected in the propagation of some species, while with others less success was attained. What is

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regarded as the most substantial gain, however, is the increase, amounting to 47 per cent, in the number of fingerlings produced and distributed. The policy of rearing larger numbers of young fish to advanced sizes was inaugurated a few years ago and has since been assiduously followed in various fields, to the gratification of those most familiar with fish-cultural methods and needs.

The following table shows by species the number of fish and fish eggs distributed during the fiscal year 1916 from the various stations of the Bureau:

SUMMARY, BY SPECIES, OF THE DISTRIBUTION OF FISH AND EGGS DURING THE FISCAL YEAR ENDED JUNE 30, 1916.

Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Catfish			2,545,777	2,545,777
Carp			4,336,832	4,336,832
Buffalofish			563,815	563,815
Shad	1,097,000	77,644,545		78,741,545
Alewife		200,000		200,000
Whitefish	74,180,000	316,975,000		391,155,000
Lake herring		76,000,000		76,000,000
Silver salmon	198,500	8,684,334	1,469,507	10,352,341
Chinook salmon	20,622,340	57,250,714	22,982,655	100,855,709
Blueback salmon	3,000,000	57,964,920	32,442,748	93,407,668
Humpback salmon		19,179,124	3,144,584	22,323,708
Dog salmon		21,500,944	1,000,000	22,500,944
Steelhead trout	1,079,000	870,600	3,811,058	5,760,658
Rainbow trout	1,489,900	243,800	2,831,747	4,565,447
Atlantic salmon		1,709,815		1,709,815
Landlocked salmon	486,000	357,968	105,777	949,745
Scotch sea trout			509	509
Blackspotted trout	1,427,000	1,370,310	2,481,228	5,278,538
Loch Leven trout			105,500	105,500
Lake trout	7,326,054	36,414,323	278,100	44,018,477
Brook trout	635,000	5,057,650	7,576,817	13,269,467
Grayling	3,500,000	1,868,000		5,368,000
Smelt	36,000,000	15,000,000		51,000,000
Mackerel		1,946,000		1,946,000
Butterfish		392,000		392,000
Crappie			3,122,332	3,122,332
Rock bass			165,149	165,149
Smallmouth black bass		762,710	65,169	827,879
Largemouth black bass		471,300	1,357,768	1,829,068
Sunfish		33,000	1,635,881	1,668,881
Pike and pickerel			43,436	43,436
Pike perch	222,160,000	214,533,280	3,460	436,696,740
Yellow perch	27,500,000	195,491,000	183,111	223,174,111
Striped bass		10,071,000		10,071,000
White perch	25,000,000	97,350,000		122,350,000
White bass			4,950	4,950
Cod		318,681,000		318,681,000
Pollock		1,107,460,000		1,107,460,000
Haddock		22,170,000		22,170,000
Flatfish		1,532,947,000		1,532,947,000
Lobster		128,700,000	3,525	128,703,525
Total	425,700,794	4,329,300,337	92,261,435	4,847,262,566

Food and game fishes were distributed in every State and Territory in the Union. The marine, Great Lakes, and anadromous species of the eastern and western coasts were practically all liberated in the waters from which the eggs were collected, and the trouts, basses, sunfishes, and other species of the interior were either consigned to inland public waters or contributed as brood stock to privately owned ponds. More than 10,000 individual applications for fish were received, and about the same number was acted on by the consignment of suitable species.

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The distribution of the output of the hatcheries at the most suitable ages and in the most economical and effective manner is a highly important branch of fish culture. The regular field equipment and staff provided for this purpose are supplemented by the detail of station employees and the use of public and private carriers, and throughout the year a large part of the fish-cultural personnel was constantly engaged in making deliveries of fish to applicants. The six railway cars specially equipped for the safe transportation of live fish of all ages were in active service at all seasons. They were hauled 149,781 miles, and, in addition, the detached messengers traveled 645,721 miles, carrying their loads of living freight. The increase in the mileage over 1915 was about 25 per cent. The policy of the various railroads differs in the matter of the treatment of fish cars and messengers. Some lines charge full rates for cars with their crews and messengers with their cans, some give substantial reductions from regular fares, and some accord free passage and hauling. In 1916 about 10½ per cent of the travel by cars and 19 per cent of the travel by messengers were furnished gratis.

The first all-steel transportation car, authorized by Congress in the appropriation act for 1915, has been completed and placed in commission. An appropriation of $40,000 for two additional cars of the same type has been made, but the increase in the cost of labor and materials renders it impossible to secure fully equipped cars within the limits of the sum provided. At the coming session Congress will be asked to appropriate the additional amount required.

The unit cost of fish-cultural operations continues to decrease and in 1916 was reduced to $117.86 per million fish produced and planted. This is to be compared with $131.65 in 1915, $146.36 in 1910, and $239 in 1905.

HATCHERIES OPERATED.

The hatcheries fall naturally into five categories, and their output in 1916 may be classified and summarized as follows:

Marine species of the Atlantic coast	3,112,299,525
Migratory species of the Atlantic coast	[a] 442,472,788
Fishes of the Great Lakes	947,870,217
Migratory fishes of the Pacific coast	248,975,220
Fishes of the interior waters	95,644,816
Total	4,847,262,566

The only new permanent hatchery opened in 1916 was the one at Saratoga, Wyo., which has begun operations under favorable auspices and gives promise of great usefulness. This station and the one at Orangeburg, S. C., were not given the full amount of money necessary for entire completion, and Congress will, therefore, be asked to provide the additional sums required.

Under the general authority to establish field stations, operations have been so successful on the Quinault River in Washington and the Klamath River in California that the construction of permanent hatcheries in these localities is warranted.

There follows a list of the hatcheries maintained in 1916, with auxiliary and field stations thereunder, the period of operation, and the species handled. The principal stations, arranged in alphabetical

[a] Includes humpback salmon planted in Maine waters.

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order, have a permanent personnel provided by law or are operated more or less independently, although the subsidiary establishments in some cases are fully equipped and quite as important as the head stations to which they are attached for convenience of administration. Some shifting of auxiliary points of operation occurs each year, and, as promising collecting locations are found, the field is expanded to such extent as the available appropriations will allow. There has been no increase in such funds for several years past, hence the extension of work has not been all that was desired or all that the needs of the various fields demand, and new work has been made possible only as the cost of production has decreased by reason of the greater experience and efficiency of the personnel.

FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1916.

Designation.	Period of operation.	Species handled.
Afognak, Alaska	Entire year	Blueback and humpback salmons.
Uganik Bay, Alaska	June–October	Blueback salmon.
Seal Harbor, Alaska	do	Do.
Baird, Cal.	Entire year	Brook and rainbow trouts and chinook salmon.
Battle Creek, Cal.	December–April	Chinook salmon.
Hornbrook, Cal.	October–May	Chinook and silver salmons.
Mill Creek, Cal.	December–April	Chinook salmon.
Baker Lake, Wash.	Entire year	Blueback and silver salmons.
Birdsview, Wash.	do	Blueback, chinook, humpback, and silver salmons; blackspotted and steelhead trouts.
Brinnon, Wash.	October–June	Dog and silver salmons and steelhead trout.
Darrington, Wash.	October–April	Chinook, dog, humpback, and silver salmons.
Day Creek, Wash.	September–June	Humpback and silver salmons.
Duckabush, Wash.	do	Chinook, dog, humpback, and silver salmons, and steelhead trout.
Illabott Creek, Wash.	do	Chinook, humpback, and silver salmons.
Quilcene, Wash.	do	Chinook, dog, humpback, and silver salmons.
Sultan, Wash.	do	Chinook, humpback, and silver salmons, and steelhead trout.
Battery, Md.	April–May	Shad, white perch, and yellow perch.
Boothbay Harbor, Me.	Entire year	Cod, flatfish, pollock, and lobster.
Portland, Me.	July–October; May–June	Lobster.
Bozeman, Mont.	Entire year	Blackspotted, brook, rainbow, and steelhead trouts, and grayling.
O'Dell Creek, Mont.	March–May	Grayling.
Meadow Creek, Mont.	do	Grayling and rainbow trout.
Yellowstone, Wyo.	July–June	Blackspotted trout.
Clear Creek, Wyo.	do	Do.
Columbine Creek, Wyo.	do	Do.
Cub Creek, Wyo.	do	Do.
Lake Camp, Wyo.	do	Do.
Bryans Point, Md.	March–May	Shad and yellow perch.
Cape Vincent, N. Y.	Entire year	Brook, lake, and rainbow trouts; lake herring; landlocked salmon; pike perch; yellow perch; and whitefish.
Amherst Island, N. Y.	October–November	Lake trout.
Charity Shoals, N. Y.	do	Lake trout and whitefish.
Horseshoe Island, N. Y.	do	Lake trout.
Ogdensburg, N. Y.	April–May	Pike perch.
Old Forge, N. Y.	November	Whitefish.
Pigeon Island, N. Y.	October–November	Lake trout.
Pope Mills, N. Y.	April	Pike perch.
Sodus Point, N. Y.	November–December	Lake herring.
Stony Island, N. Y.	November	Lake trout.
Three Mile Bay, N. Y.	November–December	Lake herring and whitefish.
Central Station, Washington, D. C.	Entire year	Shad, pike perch, and yellow perch.
Clackamas, Oreg.	do	Chinook salmon, and brook, rainbow, and steelhead trouts.
Applegate, Oreg.	April–June	Chinook and silver salmons, and rainbow and steelhead trouts.
Big White Salmon, Wash.	October–May	Chinook salmon.
Little White Salmon, Wash.	do	Do.
Rogue River, Oreg.	Entire year	Blackspotted and steelhead trouts and chinook and silver salmons.
Upper Clackamas, Oreg.	do	Chinook salmon and steelhead trout.
Willamette, Oreg.	July–June	Shad.

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FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1916—Continued.

Designation.	Period of operation.	Species handled.
Cold Springs, Ga.	Entire year	Black bass, catfish, sunfish, and warmouth bass.
Milltown, Ga.	April–June	Black bass.
Craig Brook, Me.	Entire year	Atlantic salmon, brook and Scotch sea trouts, and humpback salmon.
Upper Penobscot, Me.	April–May	Atlantic salmon.
Duluth, Minn.	Entire year	Brook, lake, and steelhead trouts, pike perch, and whitefish.
Grand Marais, Minn.	October–November	Lake trout.
Edenton, N. C.	Entire year	Black bass, rock bass, shad, sunfish, and white perch.
Weldon, N. C.	April–May	Striped bass.
Erwin, Tenn.	Entire year	Brook and rainbow trouts, large and small mouth black basses, rock bass, carp, and sunfish.
Gloucester, Mass.	do	Cod, flatfish, haddock, pollock, mackerel, and lobster.
Green Lake, Me.	do	Brook and lake trouts, humpback and landlocked salmons, and smelt.
Grand Lake Stream, Me.	do	Landlocked salmon.
Homer, Minn.	do	Black bass, buffalofish, carp, catfish, crappie, pike, pike perch, rock bass, sunfish, and yellow perch.
La Crosse, Wis.	do	Black bass, buffalofish, carp, catfish, crappie, pike, pike perch, sunfish, yellow perch, and brook and rainbow trouts.
Leadville, Colo.	do	Blackspotted, brook, lake, and rainbow trouts.
Antero Reservoir, Colo.	April–May	Rainbow trout.
Cheesman Lake, Colo.	do	Do.
Edith Lake, Colo.	October–November	Brook trout.
Engelbrechts Lake, Colo.	do	Do.
Hosselkus Lake, Colo.	do	Do.
Kelleys Lake, Colo.	do	Do.
Musgrove Lake, Colo.	do	Do.
Smiths Ponds, Colo.	do	Do.
Northfield Lake, Colo.	do	Do.
Turquoise Lake, Colo.	do	Do.
Woodland Park, Colo.	do	Do.
Louisville, Ky.	Entire year	Large and small mouth black basses, rock bass, sunfish, and rainbow trout.
Mammoth Spring, Ark.	do	Large and small mouth black basses, catfish, rock bass, and sunfish.
Friars Point, Miss.	July–December	Black bass, buffalofish, carp, catfish, crappie, and sunfish.
Manchester, Iowa.	Entire year	Brook and rainbow trouts, pike perch, rock bass, and sunfish.
Bellevue, Iowa.	August–December	Black bass, buffalofish, carp, catfish, crappie, pike, sunfish, white bass, and yellow perch.
North McGregor, Iowa.	do	Black bass, carp, catfish, buffalofish, crappie, pike, sunfish, and yellow perch.
Nashua, N. H.	Entire year	Brook and rainbow trouts, catfish, and smallmouth black bass.
Neosho, Mo.	do	Black bass, catfish, crappie, rainbow trout, rock bass, smallmouth black bass, sunfish, and yellow perch.
Northville, Mich.	do	Brook, lake, and rainbow trouts, grayling, and smallmouth black bass.
Alden, Mich.	November	Whitefish.
Alpena, Mich.	April–May	Lake trout and whitefish.
Antrim City, Mich.	November	Whitefish.
Bay City, Mich.	April	Pike perch.
Bay Port, Mich.	November	Whitefish.
Belle Isle, Mich.	October–November	Do.
Charity Island, Mich.	do	Do.
Charlevoix, Mich.	April, May, December	Lake trout and whitefish.
Detour, Mich.	October–November	Lake trout.
Detroit, Mich.	April, May, December	Pike perch and whitefish.
Fairport, Mich.	October–November	Lake trout.
Frankfort, Mich.	do	Do.
Grassy Island, Mich.	do	Lake trout and whitefish.
Isle Royal, Mich.	do	Do.
Kewaunaw Point, Mich.	do	Lake trout.
Manistique, Mich.	do	Do.
Marquette, Mich.	do	Lake trout and lake herring.
Monroe, Mich.	April and November	Pike perch and whitefish.
Munising, Mich.	October–November	Lake trout.
Munoscong, Mich.	April	Pike perch.
Naubinway, Mich.	November–December	Whitefish.
Ontonagon, Mich.	October–November	Lake trout.

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FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1916—Continued.

Designation.	Period of operation.	Species handled.
Northville, Mich—Continued.		
St. James, Mich	October-December	Lake trout and whitefish.
Sault Ste. Marie, Mich	do	Do.
Jacobsville, Mich	October-November	Lake trout.
Orangeburg, S. C	Entire year	Black bass and shad.
Put in Bay, Ohio	do	Pike perch, whitefish, and yellow perch.
Kellys Island, Ohio	November-December	Whitefish.
Middle Bass, Ohio	do	Do.
North Bass, Ohio	April and November	Pike perch and whitefish.
Port Clinton, Ohio	do	Do.
Toledo, Ohio	do	Do.
Quinault, Wash	Entire year	Blueback, chinook, and silver salmons.
Quincy, Ill	do	Black bass, carp, catfish, crappie, pike perch, sunfish, and yellow perch.
St. Johnsbury, Vt	do	Brook, lake, rainbow, and steelhead trouts, landlocked salmon, smallmouth black bass, and yellow perch.
Darling Pond, Vt	August-December	Brook trout.
Holden, Vt	Entire year	Brook, lake, rainbow, and steelhead trouts, and landlocked salmon.
Lake Mitchell, Vt	August-December	Brook trout.
Swanton, Vt	March-June	Pike perch and yellow perch.
San Marcos, Tex	Entire year	Black bass, crappie, rock bass, sunfish, and warmouth bass.
Saratoga, Wyo	do	Brook trout.
Spearfish, S. Dak	do	Blackspotted, brook, lake, Loch Leven, rainbow, and steelhead trouts.
Tupelo, Miss	do	Black bass, crappie, and sunfish.
White Sulphur Springs, W. Va	do	Brook and rainbow trouts, large and small mouth black basses.
Woods Hole, Mass	do	Cod and flatfish.
Menemsha, Mass	January-April	Flatfish.
Waquoit, Mass	do	Do.
Wickford, R. I	do	Do.
Wytheville, Va	Entire year	Brook and rainbow trouts, large and small mouth black basses, landlocked salmon, rock bass, and sunfish.
Yes Bay, Alaska	do	Blueback and humpback salmons.
Eagle Lake, Alaska	June	Blueback salmon.
Ketchikan, Alaska	September-October	Humpback salmon.

PACIFIC SALMON CULTURE.

The artificial propagation of the Pacific salmons in the three coast States and Alaska attained greater efficiency and magnitude in 1916 than in any previous year. Shortage in the egg-take at some points was more than compensated for by a high degree of success elsewhere, and the output, in round numbers, was 250,000,000 fish, compared with 225,000,000 in 1915. The most satisfactory feature of this increase was that it was made up largely of chinook and sockeye, or blueback, salmons, the most valuable of the five Pacific salmons. Humpback salmon also were produced in larger numbers, but the output of silver and dog salmons, owing to various local difficulties encountered during the spawning season, fell behind last year's record.

In pursuance of the recently adopted policy of increasing each season so far as possible the output of fingerling salmon, the rearing facilities at the Pacific stations were sufficiently enlarged during the year to permit of the production of 61,039,494 fingerling fish. This number represents about 24½ per cent of the total salmon output in 1916 and shows an increase of more than 100 per cent over the output of fingerling salmon the previous year.

The abnormal physical conditions resulting from the eruption of Mount Katmai in 1912 have now become so ameliorated that they are expected to cause no further difficulty in connection with the fish-

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cultural work at the Afognak station. However, the past season was remarkable because of an extended drouth, which at one time during the early winter became so acute that it was feared it would be necessary to plant all eggs and fry in the hatchery in order to save them. In July, 1915, when the run of blueback salmon appeared in Letnik Bay, the water in the river and lake near the station was so low that but comparatively few fish succeeded in ascending, and of those which did reach the lake a large proportion died in the shallow tributaries before ripening. The eggs of others hardened in the fish, and, altogether, considerable numbers of eggs were thus lost to the station. Notwithstanding these unfavorable conditions, the collections exceeded last year's take by a small margin and gave evidence of the zealous efforts of the hatchery force.

In addition to 6,353,000 blueback and 11,435,000 humpback eggs taken at the main station, 5,773,000 blueback and 3,523,800 humpback eggs were secured at the recently established field stations at Seal Bay and Uganik. This stock was enlarged during the early winter by the transfer from the Yes Bay station of 15,000,000 blueback eggs, which, notwithstanding the 15 days consumed in effecting the transfer, were found on arrival to be of very good quality. Besides the difficulty experienced with a short water supply, the winter was intensely severe, and the prevailing low water temperatures so retarded the incubation period that the last of the eggs were not hatched until May 29. Despite the unfavorable circumstances contended with, however, 24,513,700 blueback and 13,104,200 humpback salmon fry were hatched, and 11,169,440 of the bluebacks were carried through to the fingerling stage in good condition. All of the young humpbacks had to be liberated shortly after hatching in order to provide sufficient water for handling the fry of the more valuable species.

All the fish on hand at the Afognak station in the course of the year were free from fungus or disease with the exception of those derived from the Uganik field, a considerable number of which developed a white spot about midway of the umbilical sac near the notochord. The fry thus marked died at the end of the fifth or sixth day. The spot was discernible in the egg from 10 to 15 days before hatching, but could not be seen previous to that time with the unaided eye. So far as known, no trouble of this nature has ever before been experienced at the Afognak station.

The salmon season at the Yes Bay station was remarkable both for the unusually large number of eggs secured and for the peculiarity in the run of fish. As a rule, brood salmon enter the lake in the vicinity of the station from one to two months before they are ready to spawn, but this year close observation up to the beginning of the spawning season failed to reveal any large numbers, and it was feared that few eggs would be available. The first bluebacks were taken September 2, and the spawning season was well advanced before any material increase in the numbers of fish could be discerned. Daily collections of eggs were continued to September 29, by which date 72,000,000—representing the total capacity of the hatchery—had been taken, and, while large numbers of spawning fish were still accessible, the collections had to be discontinued.

As the incubation period advanced, the congested condition of the hatchery was relieved by the transfer of 15,000,000 eggs to the Afognak station and 3,000,000 to the Oregon State Fish Commission.

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The remainder were carried through to the hatching stage with a loss of only 2 per cent. Because of inadequate hatchery room, it was impossible to carry all of the fry, and frequent plantings had to be made in order to prevent congestion in the troughs. The absorption of the yolk sac was completed in May and feeding began the last of that month. Spent blueback salmon, salted and preserved in barrels, were utilized as food for the young fish. A meat chopper for grinding this food was set up in the dynamo room and operated with power from the dynamo turbine. Last year the salted salmon was cooked, pressed, and grated, and a meal thus obtained, and while the fingerlings thrived on it at first, their growth appeared to be arrested later and heavy mortality ensued. Whether this was due to the condition of the food or to the high temperature of the water during the period of feeding could not be determined, but in 1916 the salted salmon was freshened and ground but not cooked and better results were attained.

The substation established the previous year on Ketchikan Creek for the collection of eggs of the humpback salmon was again opened for operations, but very early in the season protests against the work were made by the citizens of Ketchikan and it was decided to abandon it. At that time only 325,000 eggs had been taken, and as the expense of carrying them until hatched would have been considerable they were deposited in the gravel of the creek where collected. A search was then instituted for a new site, and it is believed a very good one has been found on Smeaton Bay about 6 miles from the Behm Canal, where experimental work will be continued next season.

In addition to the transfers of eggs already mentioned, the output from the Yes Bay station comprised 32,920,000 fry and 20,876,000 fingerlings, and at the close of the year 650,000 fingerlings were being retained for later distribution.

At the Baker Lake station, in Washington, the work of capturing a brood stock of blueback salmon was undertaken early in July, and by the close of the collecting period 9,127 fish in good condition had been secured and placed in the slough at the head of Baker Lake to ripen. Various repairs had just been made to this inclosure to insure the safety of the impounded fish, but, despite the precautions taken, a large number of them escaped in October during a period of continuous rainfall which raised the level of the lake fully 15 feet. It is estimated that the egg collections, which amounted to 3,111,000, were at least 7,000,000 short of what they would have been had the loss of fish not occurred. In addition to this work, eggs of the chinook salmon, silver salmon, and steelhead trout, aggregating 504,200, were taken and hatched and the fry were planted locally. The output of blueback-salmon fry from Baker Lake station numbered 1,875,000, and 732,379 were still on hand at the close of the year. In the course of the year a new hatchery and barn were constructed, various improvements were made to the cottage and mess house, and a fire-service pipe line was laid.

From the Birdsview station there were distributed early in the year 620,280 blackspotted and steelhead trout fry and also fingerling, chinooks, and blueback salmons aggregating nearly 344,000, all of which had been carried over from the previous fiscal year. The run of humpback salmon in streams in the vicinity of the Birdsview sta-

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tion began early in September, but owing to the low water it was very light as compared with former years. The total humpback-egg collections amounted to 1,550,000, all of which, with the exception of 30,000 forwarded for exhibit at San Francisco, were used in making up a shipment of 7,000,000 eggs destined for New England stations, the balance of the consignment being contributed by other Washington stations. In addition to the humpback collections, 149,000 chinook-salmon eggs were taken during the fall, 1,238,000 silver-salmon eggs during the fall and winter, and 3,212,000 steelhead-trout eggs in the spring, the last take being the largest for several years.

At the Illabot Creek substation, where the run of humpback and chinook salmon was interfered with by low water, egg collections of the former numbered 2,500,000 and of the latter nearly 4,000,000. Later on the chum eggs were lost, the water in the flume and hatching troughs freezing solidly during a spell of very cold weather, despite the efforts put forth to save them. Silver-salmon egg collections were disappointing here as elsewhere, only 44,000 being taken.

Egg collections at the Puget Sound stations amounted, in round numbers, to 39,000,000, of which about 25,000,000 were of the chum, or dog, salmon, over 3,500,000 of the humpback, 7,000,000 of the silver, a little over 500,000 of the chinook, and about 3,000,000 of the steelhead trout. Plantings of fry of the various species named aggregated nearly 34,000,000. The run of humpback salmon here, as elsewhere in Washington, was light, the lack of the usual abundance of fresh water in the sound basin apparently causing the main body of the run to seek more northerly streams.

At Duckabush the pond system was completed during the year and a battery of 32 eyeing troughs was installed. In connection with the work at Quilcene a convenient slough near the station was converted into a nursery pond with a capacity for 2,000,000 fry, and an eyeing plant, consisting of a battery of 24 troughs, was constructed in the close vicinity of the trap where the fish were taken, thus obviating the loss and expense heretofore involved in the transportation of the green eggs 2 miles to the hatching station.

In advance of the blueback season in the Quinault region a battery of 86 troughs was installed in a new building 40 by 77 feet in dimensions and supplied with water from a new flume, and by October 10, when the run of salmon made its appearance, racks and traps had been built in three creeks emptying into Quinault Lake and River and everything was in readiness for the collection of eggs, which began three days later. From that time on collections were made daily until December 18, on which date, the hatchery being filled, the racks were withdrawn and a considerable number of unspawned fish was set free.

Two kinds of apparatus were used to capture the fish, namely, upstream traps and seines, the latter being employed in deep holes in the creeks and in the upper part of the river. In some of the seine hauls as many as a thousand fish, nearly all of them ripe, were taken at a time. The run was said by the native Indians to be the largest ever known in that region. The 18,000,000 eggs constituting the season's take were transferred by station launch to the field hatchery, and, notwithstanding the intensely cold weather encountered during the winter—the ice formation on the hatchery floor being at one time 6 inches thick—they were of such excellent quality as to pro-

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duce 91 per cent of fry. A consignment of 50,000 blueback-salmon eggs from the Yes Bay collections was transferred to this station during the fall with the view of utilizing the young fish hatched therefrom in marking experiments.

From the entire stock on hand 16,580,946 vigorous fry were produced, most of which, owing to lack of rearing facilities, had to be liberated before the absorption of the yolk sac. Incidental to the work with this species, small numbers of eggs of the chinook and silver salmons were taken, hatched, and distributed, the output of fry from both lots amounting to 135,924.

Coming now to the Oregon field, it may be noted that for the first time in some years all natural conditions on the Clackamas River were favorable for chinook-salmon work, and during the spawning season, which extended from September 23 to November 17, eggs in excess of 10,000,000 were collected, the take being nearly two and a half times larger than in the previous year. Two millions of these were transferred to the upper Clackamas hatchery with the view of rearing the resulting fry and planting them in the headwaters of that river. Of those hatched at Clackamas station, 2,500,000 were planted on the absorption of the food sac and the remaining 1,500,000 were fed until April and then liberated, both lots being returned to the spawning grounds from which the eggs were secured. As at the other Pacific stations, the principal food used was the flesh of salted salmon, 8 tons of which had been prepared in advance.

Fishing operations on the upper Clackamas were almost impracticable, owing to the absence of slack water at the foot of the fishway dam, and while there was a fair run of salmon in sight only 24,000 eggs were secured.

The collection of chinook eggs on tributaries of the Columbia River amounted to nearly 50,000,000, over two-thirds of them being taken on the Little White Salmon River. As the station on that stream is equipped for handling only about 25,000,000 eggs, the surplus of 9,000,000 was utilized in fully stocking the hatchery on the Big White Salmon, where collections of 13,200,000 eggs had been made. The eggs at both points were hatched with normal losses, and the combined output aggregated 43,822,000 fish, of which 6,670,665 were fingerlings.

Nearly 6,000,000 chinook eggs were taken at the Rogue River station, and 1,000,000 of these were supplied to the Oregon State Fish Commission. From the remainder there was an output of 1,952,000 fry and 1,550,037 fingerling fish. Steelhead-trout eggs to the number of 405,700 were collected from this river during the spring, and more would have been secured had not the high water permitted many of the impounded fish to escape. Of the cutthroat trout, which ran with the steelheads, a few fish were secured that yielded 23,000 eggs.

On the tributary stream at Applegate Creek 601,000 chinook and 782,500 silver-salmon eggs were obtained and handled with the usual mortality, and during the spring 4,148,000 steelhead eggs were taken. In the operations with this latter species very successful use was made of a section of irrigation ditch for impounding partly ripe fish, permission having first been obtained from the owners of the property. In connection with the work at this point a small number of

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Lake Tahoe trout fry belonging to the Oregon State Fish Commission were held, fed, and at length liberated in Crater Creek.

The hatching of shad on a minor scale has been continued in the Columbia basin. During the early part of the fiscal year 317,445 eggs on hand July 1 were hatched and the fry were liberated on the spawning grounds in the Willamette River. Near the close of the year shad-egg collections were again made, and by the last of June nearly 3,000,000 fry had been hatched and planted.

The chinook-egg collections in the California field were about 7,000,000 behind those of the previous year, the shortage being due partly to failure to obtain eggs on the McCloud River and partly to unfavorable water stages during the spawning season at both the Mill Creek and the Battle Creek stations. The streams on which these stations are located were so low during the first part of the season that the fish could not ascend, and the heavy rains occurring later resulted in floods which damaged the racks and put an end to the work by allowing all fish held below them to escape.

At the Baird station shortage of funds made it impossible to install the racks in the McCloud River at the usual time during the spring, and before their completion in July the major portion of the run of salmon had passed upstream. The egg collections at the two auxiliary stations referred to aggregated only 26,747,000, but the shortage as compared with last year was largely overcome by the unexpected success attained at the Hornbrook substation, where 16,460,000 chinook eggs were secured from the Klamath River besides eggs of the silver salmon to the number of 2,823,000. While the facilities at Hornbrook had only recently been enlarged, the hatching capacity of the station is still far too small to permit of the handling of such numbers. It was, therefore, arranged to have the State fishery authorities develop the surplus eggs at the Sisson hatchery and return the fry by means of the State fish car for liberation on the spawning grounds in the Klamath River. All of the silver-salmon eggs were hatched at the point of collection and the fry were returned to the river without feeding.

The salmon output from the Battle Creek and Mill Creek stations consisted of 9,505,000 fry and 12,373,224 fingerlings. Attempts were made in April to collect eggs of the rainbow trout in Cottonwood Creek, a tributary of the Klamath, but for some unknown reason the usual run of fish in this stream failed to make its appearance and only 26,640 eggs were obtained. These were transferred to the Baird station to be hatched, and the fry were utilized in supplying California applicants.

PROPAGATION OF MIGRATORY FISHES OF ATLANTIC STREAMS.

This branch of the fish-cultural work is addressed to the shad, Atlantic salmon, striped bass, white perch, and yellow perch.

Contrary to the experience of recent years, the shad season on the Potomac River was comparatively successful from the viewpoint of artificial propagation as well as in financial returns to the commercial fishermen, whose catch was estimated to be fully 50 per cent greater than in any previous year since 1896. The fish appeared on the spawning grounds in plentiful numbers shortly after the middle of April, but for about 15 days thereafter the water temperatures were

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too low for the ripening of the eggs. During the latter half of the season, however, favorable conditions prevailed and 63,815,000 eggs were secured. These were hatched at the station, with the exception of 2,076,000 shipped on assignments, and the resulting fry—58,232,700 in number—were widely distributed on the natural spawning grounds in the Potomac River.

The satisfactory outcome of the shad season on this river, in strong contrast with the failures in recent years, is to be attributed, in part, to the restrictions imposed by the War Department on the pound-net fishermen operating in Chesapeake Bay and at the mouths of the tributary rivers. Definite lanes for navigation have been kept open, and the migrating schools have thus had a clearer passage than heretofore to their spawning grounds in the upper part of the stream. The large run in 1916 may be attributed also to the favorable conditions for spawning four years before, when extensive egg collections were made.

In advance of the shad season on the Potomac, 16,013 adult yellow perch were collected from the fishermen's nets and placed in live cars. Here they began spawning at once and between March 29 and April 7 produced 152,235,000 eggs. Of these, 3,640,000 were used for exhibition purposes at Central Station, Washington, D. C., and from the remainder 137,101,000 excellent fry were hatched, all of which were planted in fine condition in tributary streams of the Potomac River, extending from Broad Creek, Md., to Occoquan Creek, Va., this territory comprising the principal breeding ground of the species.

The shad operations on the Susquehanna River were attended by the usual discouraging results. On this river a specially destructive fishing device—the anchored gill net—is in extensive use at the present time, to the almost total exclusion of the drift net, from which eggs of good quality have always been derived. In practice the anchored net is allowed to remain in position throughout the night, and on being lifted in the morning nearly all the shad with ripe eggs are found in a mutilated condition, having been preyed upon by eels.

The spring's work on the Susquehanna included the collecting of 67,512,000 yellow-perch eggs, 153,700,000 white-perch eggs, and 6,583,000 shad eggs. Eggs of the first-named species were obtained between April 3 and April 10, and the station output comprised 25,500,000 eggs shipped on assignment, besides 33,400,000 fry. The white-perch season extended from April 15 to the end of that month. Of the eggs secured, 25,000,000 were supplied to applicants and the remainder produced 96,500,000 fry. The first shad eggs were taken April 19, and while the fishing season was long drawn out, extending far into June, eggs came into the hatchery in such small lots that it was deemed advisable on May 13 to discontinue this work, and the station was closed shortly afterwards.

In Albemarle Sound slightly over 16,000,000 shad eggs constituted the season's collections, making it one of the poorest experienced since the establishment of the Bureau's station in that region. While the unfavorable showing was due in some measure to the cold northerly winds which prevailed throughout the spawning period, it is yearly becoming more evident that the Bureau's efforts to maintain the shad fisheries of Albemarle Sound are not appreciated by all those who are deriving most of the benefit therefrom. The gill-net

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fishermen, to whose cooperation the Bureau is indebted for the successful shad work in recent years, are gradually being driven off the spawning grounds by the encroachments of the pound-net fishermen, who apparently take no interest in the work of artificial shad propagation. The records of the Edenton station show that the number of fishermen—principally gillers—furnishing eggs to the hatchery increased from 31 in 1910 to 67 in 1913, in which year the largest egg collections in the station's history were made. Since that time the operations of the gillers have rapidly declined, and only 17 were left to furnish eggs for the Bureau's work in 1916. The output of fry from the eggs obtained numbered 9,765,000.

Plans were made early in the spring at the Edenton station to undertake the hatching of the white perch, but the efforts to obtain eggs resulted in practical failure, only 1,200,000 being secured. The reason advanced for this poor outcome is the irregularity and uncertainty of the ripening of the fish, a feature which, from all accounts, has always existed in the Albemarle Sound region. The collection of these eggs began in March and extended well into April, and the output of fry was 850,000.

With the view of prosecuting striped-bass work on a more efficient and extensive basis than heretofore, a time lease was secured on a building on the west bank of the Roanoke River, which was fitted up in advance of the spawning season. The opening of the spawning season was delayed by heavy rains in April, but, aside from the shortening of the season by its late beginning, natural conditions were quite favorable and the season proved to be very successful, 13,325,000 eggs being taken and 10,071,000 fry hatched therefrom.

The shad work was extended during the year by the establishment and operation of two auxiliaries of the Orangeburg station on the Edisto River, S. C., and by the opening of an experimental field station on the Cape Fear River in North Carolina.

The spawning season on the Edisto was very short, and just at its height the work was stopped by the State warden, owing to some doubt on his part as to the legality of the fishing methods inaugurated in connection therewith. Before this difficulty could be cleared up and fishing resumed most of the run of shad had passed up the river. But for this interference considerable collections of eggs would, doubtless, have been made, as fish in spawning condition were fairly plentiful. The outcome was that 605,000 eggs were collected for the plant at Jacksonboro and 347,000 for the Branchville auxiliary. The output of fry from these two points amounted to 772,000, which were returned to the Edisto River in the immediate vicinity of the stations.

The shad work on the Cape Fear River was undertaken largely at the request of the State authorities and Members of Congress, in order that the fishermen of that section of the State might receive some recognition for having been brought—very tardily, it must be said—under the provisions of the protective fishery laws that for years had applied to other parts of the State. The steamer *Fish Hawk*, equipped as a floating hatchery, was sent to the river, and a temporary hatching plant was set up at a convenient point on the river bank above Wilmington.

The run of shad on the Cape Fear proved to be small, and of the shad taken at the various fisheries only one individual with ripe eggs

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was found by the spawn takers detailed for the work. The material results of this experiment were, therefore, wholly negative, but the experience gained will doubtless be helpful in connection with any future operations which may be considered for that field.

Atlantic salmon operations on the usual scale were conducted at the Craig Brook, Me., station. In June of the previous year a brood stock of 725 fish had been purchased and transferred to the station inclosure until spawning time in October, when 1,953,400 eggs were yielded. Early in the winter consignments of eggs to the number of 1,770,400 were transferred to the subhatchery near the headwaters of the Penobscot River for development, and all of the fry hatched—1,709,815—were liberated in the east branch of that river during May and June, 1916. The fish from which the eggs were derived were liberated immediately after spawning at the head of tidewater in Orland River.

In the spring of 1916 the run of Atlantic salmon in the Penobscot was reported to be the largest since 1912, and no difficulty was experienced in securing 1,031 adults to serve as a brood stock for the coming season, the number exceeding by several hundred the brood stock of the two previous seasons. The sentiment of the local fishermen has undergone an entire change, and they are now anxious to cooperate with the Bureau, whereas in past years many of them have been in doubt as to the value of its work with this species.

FISH CULTURE IN THE GREAT LAKES.

While the weather conditions prevailing at the Great Lakes stations during the spawning season of the commercial fishes were not uniformly unfavorable, they seriously handicapped the work in some of the more important fields and caused a reduction of about one-fifth in the collections of lake-trout and whitefish eggs as compared with the previous year. The results of the pike-perch operations were more satisfactory, but the effects of an abnormally cold, late spring are clearly shown by the material shortages in eggs taken and fry planted.

Beginning October 1 arrangements were made for the usual collections of lake-trout eggs in Lake Superior waters, field stations for the purpose being opened at Isle Royale, Marquette, Munising, Ontonagon, Jacobsville, and Keystone, on the Michigan shore, and at Grand Marais, in Minnesota. From these various points 23,070,000 eggs of excellent quality were secured and also 2,668,000 whitefish eggs, all of which were forwarded to the Duluth hatchery for development.

Of the lake-trout eggs 3,509,724 were shipped in the eyed stage to State and private hatcheries, all of the consignments reaching their destinations in excellent condition. The remainder were hatched and 14,390,000 fry were distributed during March and April. A small number of lake-trout fry were held and fed to the fingerling stage. This stock when distributed in early June numbered 211,000.

The small collection of whitefish eggs was supplemented by the transfer of 25,000,000 green eggs to Duluth from the Lake Erie field in December, and from the total stock of that species handled 18,575,000 fine healthy fry were produced and planted in suitable parts of Lake Superior. In April 17,750,000 pike-perch eggs were trans-

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ferred to Duluth from collecting points in Lake Huron. These eggs were of exceptionally poor quality and the losses sustained during incubation were far above normal. However, owing to their slow development in intensely cold water, the 3,800,000 fry hatched were of good quality. This stock was utilized in filling applications submitted from North Dakota, Michigan, and Minnesota, the distribution occurring in late May and early June.

In addition to operations with the commercial species, the Duluth station had an output of 376,000 brook trout and 44,500 steelheads, the eggs of the former having been purchased from commercial fish culturists, while those of the latter were transferred from one of the Pacific stations.

In the lake-trout fields covered by the Michigan stations the spawning season opened October 18, a few days in advance of former years, and closed 10 days earlier than usual, shortening the egg-collecting period about one-third as compared with 1914. Owing partly to this fact and partly to unfavorable weather the catch of fish was reduced to almost 50 per cent of a normal take. The prevailing high winds frequently prevented the lifting of the fishermen's nets for periods of five to seven days in succession. As a consequence many of the eggs were of very poor quality, and of the 43,544,000 taken at all points 17,461,800, or 41 per cent, were lost before the eye-spots developed. When sufficiently advanced for shipment, 9,674,200 were forwarded to other Great Lakes stations of the Bureau and to State hatcheries in Wisconsin and Michigan. The output of fry from the balance numbered 16,408,000, all of which were returned to the spawning grounds in Lakes Michigan and Huron, with the exception of 2,000,000. This lot was deposited in Whitefish Bay, an arm of Lake Superior.

The first whitefish eggs for stocking the Michigan stations were taken October 11 at the Charity Island fishery, in Saginaw Bay, and the last on December 20 at Northport, Lake Michigan. In addition to the two points mentioned field stations were maintained at Naubinway, St. James, Antrim City, and Traverse City, and an experimental collecting point was opened at Alden, on Torch Lake, to determine the feasibility of taking whitefish from inland waters in sufficient quantities to warrant the expense. From the knowledge thus gained it is believed the work in this direction can be advantageously extended through next year.

Collections were made as usual in the Detroit River at the Belle Isle fishery, and the old Grassy Island fishery was operated again for the first time since the dredging of the river channel. The results of the work at the latter point demonstrated conclusively that it has been permanently destroyed as a whitefish spawning ground.

As in the lake-trout work, extremely rough weather was encountered during the major portion of the whitefish spawning season, obstructing fishing operations to such an extent that the catch was hardly half that of an average year. Especially poor results were attained at the Charity Island fishery, where the field is so exposed that the nets were either blown out entirely or the high winds made it impossible to lift them for days at a time. In round numbers, the Detroit River fisheries yielded 25,000,000 eggs, the one at Charity Island 18,500,000, and those in upper Lake Michigan 72,500,000.

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The supply was further augmented by the transfer of nearly 26,000,000 green eggs to Detroit from the Monroe Piers fishery, in Lake Erie, making a total stock of 141,880,000, of which 116,120,000 were developed to the eyed stage, the losses up to that time amounting to slightly over 18 per cent. When sufficiently advanced for shipment, 90,000,000 eggs were forwarded to the Charlevoix, Alpena, and Sault Ste. Marie subhatcheries, which are in the immediate vicinity of the spawning grounds in the upper lake; 6,120,000 were used to fill applications; and from the remainder 18,500,000 of fry were hatched and planted in the Detroit River.

Pike-perch operations during the spring in Michigan fields were prosecuted under such unfavorable conditions that up to the end of April, when large quantities of ice still covered the most prolific spawning grounds, it was feared that the season would be a total failure. The prospects improved, however, with the disappearance of the ice early in May, and the egg collections at the close of the season amounted to 166,800,000, the majority of which were taken in Saginaw Bay and in Munoscong Bay in the St. Marys River. Permission to operate in the latter field was granted by the Michigan fishery authorities as an experiment, and, as over 70,000,000 eggs were taken, it is hoped the work will be continued in that territory.

While in the green state 18,750,000 pike-perch eggs were transferred to the Duluth station and 12,600,000 to the substation at Sault Ste. Marie, the latter shipment being designed to test the practicability of hatching there the pike-perch fry required for applicants in the upper peninsula of Michigan. The water supply proved too cold, however, and all of the eggs perished. Of the 135,450,000 eggs laid down in the Detroit hatchery, only 44,235,000 survived to the eyed stage, about 32½ per cent of the original number. The fry hatched therefrom were utilized in filling various applications and in stocking public waters where egg collections had been made.

The whitefish spawning season in Lake Erie was attended by several peculiar features. Although the water temperatures of the lake were below the average during the greater part of the summer, no whitefish whatever appeared on the spawning grounds until after the middle of November, and egg collections for the Put in Bay station were possible only from November 18 to December 7, making it one of the shortest spawning seasons on record.

As a rule, when whitefish seek the head of Lake Erie at the approach of the spawning season they congregate upon the reefs and shoals for the deposition of their eggs. In this instance, however, all but a very few remained in the deeper waters. This departure from the usual habit is probably accounted for by the prevailing heavy west winds, which had a tendency to blow the water away from the west end of the lake, making it very shallow and rough on the usual spawning grounds. At Monroe Piers, which in recent years has been one of the best whitefish fields operated by the Bureau, fish were so scarce that only a very few partly ripe ones were available for penning. From penned fish and from collections made directly from the fishermen only 40,720,000 eggs were secured, as against a three-year average of 170,000,000 in the same field.

Taking the work as a whole, however, and making allowance for the short spawning season, the results were quite satisfactory, as,

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with the exception of Monroe Piers, eggs were fairly plentiful in all the fields operated, though their quality was not quite equal to last year's. Collections of eggs from all sources aggregated 351,260,000, of which 135,260,000 were shipped direct from the field in the green state to fill the applications of various State fish commissions and to supply deficiencies in the stock at other Great Lakes hatcheries of the Bureau, leaving 215,021,000 for development at the home station. From this stock 175,500,000 healthy, vigorous fry were produced, all of which were liberated in April on the various spawning grounds in Lake Erie.

The weather conditions on Lake Erie early in April were unfavorable for pike-perch work, as the ice was blown by the prevailing winds to the upper end of the lake and held there until it had practically all melted, preventing the manipulation of the fishermen's nets, retarding the run of fish, and delaying the spawning season some time beyond its usual opening. Eggs were not received in noteworthy quantities until April 17, and even after spawning began there seemed to be no regular run of fish at any point except in the vicinity of Port Clinton, Ohio. At all of the other fisheries the collections fell far short of an average season. The total take of eggs amounted to 445,775,000, about 66,000,000 less than in the previous year. Assignments of green and eyed eggs aggregating 180,000,000 were furnished to various Federal, State, and private hatcheries, and from the remaining stock 68,300,000 fry were produced and distributed practically without loss, the percentage of hatch being only 32½.

Lake-trout eggs for the Cape Vincent station were obtained from fishermen operating at Amherst, Wolfe, and Pigeon Islands, Canada, and from those working near the Galloo and Stony Islands and at Charity Shoals, N. Y. From these various sources over a million eggs were secured, but, owing to interference with the work by several severe storms, some of them were held in the field too long for successful development and only 717,000 good eggs reached the hatchery. These produced 363,186 fry, which were planted on the spawning grounds in Lake Ontario, together with 5,190,000, resulting from a shipment of eggs transferred to Cape Vincent from another lake.

Whitefish eggs for the Cape Vincent hatchery were secured from commercial dealers operating at the various fisheries on Lake Ontario, and collections in cooperation with the State fisheries authorities were undertaken at Old Forge and Lake Saranac, N. Y. From these various sources 10,862,000 were obtained, of which 3,800,000 were of the small Stanley whitefish, derived from Lake Saranac. This stock being insufficient to fill the requirements of the region, eggs to the number of 15,000,000 were forwarded in the green state from the Lake Erie fields. The output of fry from both lots, amounting to 12,900,000, indicates a very low percentage of hatch, due in large measure to the inferior quality of the western eggs. In conjunction with the whitefish collections, 106,875,000 lake herring, or cisco, eggs were purchased from the commercial fishermen of Lake Ontario and hatched, yielding a total of 76,000,000 fry for distribution on the local spawning grounds.

During the spring months the collection of pike-perch eggs for stocking the Cape Vincent station was undertaken in cooperation with State officials at Ogdensburg, N. Y. From this source 70,250,000 eggs were obtained as the Bureau's share, and, after being sufficiently

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hardened in a small temporary battery at Ogdensburg, they were forwarded to the Cape Vincent station for development. The stock was further supplemented by 55,000,000 green eggs from the Swanton field, and from the two lots about 50,000,000 were hatched and distributed in the public waters of the region.

As in the Great Lakes, the pike-perch spawning grounds in Lake Champlain were covered with ice at the time the spawning of that species occurs during a normal season. However, large numbers of fully matured fish later ascended the Missisquoi River, and from the nets of the commercial fishermen there were secured eggs sufficient to stock the Swanton hatchery.

The arrangements that have been in force on Lake Champlain for the past three years were again put into effect, three crews being operated, and all ripe female fish available were purchased of the fishermen and taken direct to the spawning station and stripped. Egg collections extended from April 17 to the end of the month, the number secured amounting to 374,075,000, of which 84,125,000 green and eyed eggs were utilized in filling applications and in stocking various Federal hatcheries.

The water supply for the Swanton station is furnished by the village water company and is of excellent quality, but the quantity available for the work is at times uncertain. It having become apparent early in the season that the supply would be insufficient for the conduct of the hatching operations in the usual manner, steps were taken to install an electrically driven pump, and by this means the outflow from the fry tanks was run back to the upper supply trough and used over and over, a small quantity of fresh water being constantly added and a like amount of used water discarded. As far as could be observed, no ill effects to fry or eggs resulted from this arrangement.

The incubation period was retarded by the cold, inclement weather prevailing through May, but, hatching having once begun, all the fry came out about the same time, necessitating very rapid and constant work in making shipments to applicants and to public waters.

For the purpose of effecting a wider distribution of pike perch in the southern sections of Lake Champlain than is possible when shipped from Swanton a cooperative arrangement was entered into with the Vermont fishery authorities whereby the Bureau agreed to construct and operate a portable hatchery at Burlington, Vt., the State to bear the expense of the undertaking. The plant, consisting of a 100-jar battery, a supply tank, and 2 collecting tanks, was gotten in shape and transferred in sections by the station launch from Swanton to Burlington, where it was set up on the dock of the Champlain Transportation Co. and covered with a canvas shelter. By means of pumps, driven by an electric motor, the water supply for the hatchery was conveyed from the lake to the supply tank installed on one of the dock buildings and from there conducted by gravity to the upper trough of the battery. About 30,000,000 eyed eggs, transferred from Swanton station, were successfully hatched in this outfit, and, as the water supply was of lower temperature than at Swanton, the hatching period was retarded sufficiently to make it possible to distribute the product after the fry at Swanton had been disposed of. The Bureau is indebted to the Champlain Transportation Co. and to various owners of private motor boats, who rendered valuable assistance in effecting a wide distribution of the fry in the open waters of the lake.

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OPERATIONS OF THE INLAND HATCHERIES.

It is possible to record another successful year's work at the numerous interior stations where trouts and basses are cultivated. These fishes bring the Bureau's activities in practical touch with very large numbers of farmers, anglers, and other individuals usually interested in the stocking of minor lakes, ponds, and streams. The recognition of the value of fish culture on the farm and of the possibility of maintaining a fish pond on practically every farm in the country is becoming more widespread as the Bureau's efforts to this end are more generally made known. Many daily newspapers and several monthly home journals with very large circulation have ably seconded the Bureau's propaganda, and as a result of all the publicity there has been a demand for thousands of copies of "Fish ponds on farms," a document prepared for the special purpose of giving practical instructions for making and maintaining private fish ponds. Already many hundreds of people in all parts of the country have acted on the information thus acquired, have obtained supplies of suitable fishes from the Bureau, and have added pond culture to their agricultural pursuits.

The aggregate output of pond fishes in 1916 was not equal to that in 1915, but with the increased production of certain species at certain stations and the larger average sizes of the fishes distributed the general results have been far more satisfactory than in any preceding year.

The only material falling off in the operations of the trout stations occurred in Yellowstone Park, where the important work addressed to the blackspotted trout was curtailed by peculiar physical conditions that affected spawning. In the summer of 1915 the water stages in Yellowstone Lake and tributary streams were from 2 to 3 feet below normal, and while thousands of spawning fish made their appearance in the lake only a small proportion entered the streams in which traps for their capture had been installed. As a result the egg collections were less than half those of the preceding year. In the spring of 1916, at the time when the spawning of the blackspotted trout usually begins, floods and washouts were prevalent in the waters of the park, owing to the melting of the heavy masses of snow in the mountains, and, while the prospects indicated a successful collecting season later on, no eggs whatever had been taken up to the close of the fiscal year.

The Madison Valley, in Montana, where Federal fish-cultural operations were inaugurated several years ago, is proving a prolific field, now that the Bureau has the hearty cooperation of the Montana authorities in the enforcement of the State law prohibiting public fishing during the close season. Heretofore the Bureau has been compelled to submit to a large amount of illegal fishing in connection with its rainbow-trout operations in this field, the nuisance assuming such proportions in the spring of 1915 as to practically nullify its efforts with that species. Steps were, therefore, taken in advance of the recent spawning season to secure the aid of the State wardens, and under the efficient protection thus afforded wild rainbow-trout eggs in excess of 1,700,000 were taken. A notable collection of grayling eggs also was made in streams in Madison Valley, the season's aggregate amounting to nearly 6,500,000.

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Brook-trout field operations in connection with the Leadville station were prosecuted as usual and resulted in a normal take of eggs. The newly exploited field near Creede, Colo., promises to yield large returns in brook-trout eggs at small cost, but the prospects for future rainbow-trout development are not encouraging, as the spawning season of that species in the Rocky Mountain States is usually coincident with very unfavorable climatic conditions. Efforts were made during the past spring by the superintendent of the new station at Saratoga, Wyo., to establish rainbow-trout collecting stations, but without any marked degree of success. There is a growing demand for the rainbow trout in the Rocky Mountain region, and the Bureau's hatcheries are doing their utmost to meet it.

A large percentage of the trout produced at the Leadville, Spearfish, and Bozeman hatcheries has in late years been distributed in waters of the national forests. A program for the systematic stocking of such streams and lakes has been agreed on with the Department of the Interior, and the Bureau is following it out to the full extent of its facilities.

The trout hatcheries of the Mississippi Valley and the North Atlantic States supplied the usual numbers for distribution, and, owing to improved water supplies, the heavy losses sustained by some stations in 1915 were not repeated. Considerable improvement was shown in the condition of the stock of certain stations, and at St. Johnsbury the epidemic of former years assumed a very mild form. Owing to this fact, the output of brook trout at that station was larger by one-fourth than in the preceding year. The Craig Brook, Me., hatchery made notable progress in trout culture, its distributions comprising 936,410 fingerlings, against 173,408 fry in 1915. More important than the increased numbers was the success attained in rearing large fingerling fish, which have been greatly needed for stocking the waters of Maine and adjacent States.

The operations with landlocked salmon at the Green Lake hatchery and its auxiliary at Grand Lake Stream resulted in a gain of 38 per cent over the egg collections of the previous year. The perpetuation of the landlocked salmon is a very important feature of the Bureau's work. This species has been widely sought by the sportsmen of far distant States, but, owing to the limited supply, it has been deemed best to confine the distribution to those waters of New England where the natural conditions approach most closely to those of its natural habitat. It is hoped to extend the field for egg collections, and with that end in view several thousand fry are being reared at the Craig Brook station for the purpose of stocking a lake in the vicinity, where the natural conditions seem to be entirely favorable.

The Mammoth Spring, Ark., output was curtailed by reason of a flood sweeping through the pond system in August, 1915, and carrying out many fingerling fish that were being held for fall distribution and also a large part of the brood stock. Later additions to the breeding fish proved inferior to those lost, and several seasons will probably be required to bring the station back to its former efficiency.

The Tupelo, Miss., station produced practically the same numbers of pond fishes as in 1915. This hatchery has made marked progress during the past few years and now ranks third in the production of bass. The outlook appears to justify the recommendation that the pond system be completed in accordance with the original plans.

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The Cold Spring, Ga., hatchery doubled its black-bass output of the preceding year. The gain is attributed to new brood stock and to the location of a new and valuable collecting field at Milltown, Ga. With nominal expenditures for fixed equipment at Milltown, the superintendent predicts that the output another year can be increased by 400 per cent.

The Orangeburg, S. C., station has proved wonderfully successful in black-bass propagation, distributing during the spring months 135,000 fingerlings, and at the end of the fiscal year many thousands remained in the ponds for fall assignment. This is the first season's fish-cultural operations at the Orangeburg station, and the results portend conspicuous efficiency for the future.

Pond-cultural operations at the combination trout and bass stations were practically a duplication of former years. At St. Johnsbury, Vt., the superintendent has taken up the collection of smallmouth black-bass fry from Crystal and Tarleton Lakes, transplanting them in the station ponds to be held until they are of fingerling size. The collections are from lakes that the State officials desire to reserve for trout and salmon, and liberal plants of the latter are made in return for the bass fry collected. While the output is relatively small as compared with that of the exclusively pond stations, the availability of bass for special distribution in New England is of such importance that the output is of great value and comes near to satisfying the demand for that species in that region.

Besides the commercial fishes before mentioned, the Northville, Mich., station hatched and distributed 771,000 brook-trout fry, 190,000 rainbow-trout fry and fingerlings, and a few thousand grayling fry. The eggs of the first named were purchased and the others were transferred from stations of the Bureau. It also produced in the station ponds during the year 326,125 fry and fingerling smallmouth black bass.

One of the most successful features of pond culture has been the noteworthy production of the smallmouth black bass at Northville. At this station 600,000 fry were hatched; of these 288,000 were immediately shipped and the remainder held for rearing. At the close of the year 38,125 had been distributed, and it is estimated that 3 carloads remained in the ponds for later shipment. With this stock the Bureau will be able to quite thoroughly supply all old applications for this species in Michigan, Wisconsin, Minnesota, and Ohio. Such favorable conditions for smallmouth black-bass propagation as are apparent at Northville will be taken advantage of and the facilities improved in order that the output may be further enhanced. This species is very difficult to propagate under average conditions, and as the demands for it are annually increasing every opportunity will be taken advantage of to meet it.

MARINE FISH-CULTURAL WORK.

The output of all species propagated at the marine stations was materially larger than in the preceding year, with the exception of the lobster. The work at these stations was conducted along the usual lines and on the whole was successful, though it was hampered to some extent by unfavorable climatic and other uncontrollable conditions.

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During the summer and fall of 1915 berried lobsters to the number of 17,808 were purchased and placed in the Boothbay Harbor pound, to be carried through the winter. When removed in April this stock was found not to have stood confinement well, the loss amounting to 4,898 individuals, or 29 per cent of the original number, while among the survivors barren and scantily egged ones were plentiful. Only 123,929,000 eggs were realized, an average of less than 10,000 per lobster, which is a very low average. The poor results may in part be attributed to an abnormally warm fall and winter. No ice formed on the pound until the middle of February, and as a consequence the lobsters failed to burrow in the mud and remain quiet, as they usually do, and losses of eggs were caused by their continual crawling over the bottom of the inclosure. The high temperature also forced the development of the eggs and caused the hatching of large numbers in the pound, this being evidenced by the appearance of many of the lobsters. A contributing cause of loss was the impossibility of securing suitable food at all times. A compensating feature of the year's work was that the quality of the fry produced and distributed was most excellent.

Additions to the supply of lobster eggs for this station were made by the purchase of 6,510,000, resulting from 289 berried lobsters which had been collected by the Maine Department of Sea and Shore Fisheries during the winter and held in live cars; also by collections from freshly caught lobsters during the spring months. The latter numbered 476, and from them 13,164,000 eggs were obtained, an average of 28,000 per lobster.

In February a search was instituted for cod eggs, and a little later for haddock eggs also, regular trips being made to the fishing grounds by the station steamer and a force of spawn takers whenever the weather permitted. Very few fish of either species were taken, however, and there was an entire absence of haddock in spawning condition. As a result of the spring's work 11,203,000 cod eggs were taken, a very small return for the effort expended.

During March and April 5,450 brood flatfish, taken in fyke nets in the vicinity of the station, were placed in retaining tanks in the hatchery. Part of these fish were allowed to spawn naturally, while the others were overhauled daily and the mature eggs taken and fertilized. Altogether 618,308,000 eggs were obtained, from which 583,707,000 fry were hatched and distributed. This egg yield not only represents the largest number ever obtained at Boothbay Harbor station, but the losses during incubation were smaller than heretofore and the fry hatched were strong and of excellent quality.

The surplus pollock eggs accumulating at the Gloucester station from time to time during the winter were transferred by means of the steamer *Gannet* to the Boothbay Harbor station, four trips being made for the purpose. As on previous occasions, the eggs did not stand transportation well; and, though various methods were employed in making the shipments, all were equally unsuccessful, only 48,892,000 of the original 126,080,000 carried reaching the station in good order.

During the first two months of the fiscal year the employees of the Gloucester station made small collections of eggs of the mackerel and butterfish. The mackerel eggs proved very poor and only an insignificant number of fry were hatched, but the butterfish eggs yielded

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a large percentage of fry of good quality. Again in June, 1916, a few million mackerel eggs were collected, and these were in course of incubation at the end of the fiscal year.

Pollock work at the Gloucester station was taken up November 1, the crew of the *Grampus* and several temporary spawn takers being assigned to make egg collections from gill-net fishermen operating in the vicinity of Cape Ann. Up to the middle of December the supply of eggs was merely normal, but during the last half of the month and all during January the daily receipts were heavy, often exceeding 75,000,000, and on one occasion 129,000,000 were secured. These enormous daily collections several times filled the hatchery to overflowing and left a large surplus stock to be otherwise disposed of. The spawning season extended from November 1 to February 17, and the aggregate collections amounted to 1,713,730,000, of which 126,000,000 were sent to Boothbay Harbor station for incubation and 335,620,000, for want of hatching facilities, were planted in the open sea off Gloucester. The eggs incubated at the station produced 752,040,000 fry.

Commercial fishermen began operating for cod in fields adjacent to the Gloucester station in January, but no ripe eggs were secured until February 10. The bulk of the season's collections, which were materially larger than in the past two years, was obtained in March and the first week in April. In the second week of April, when ripe fish were still plentiful, the spawning season was brought to a sudden close by heavy spring freshets, which caused the surface water all along the shore, and from 15 to 20 miles out, to become quite fresh. The total number of eggs obtained was 145,630,000, from which there was a hatch of 94,550,000 fry.

From fyke nets operated near the outer harbor at Gloucester in late winter a sufficient number of gravid flatfish were obtained to yield 219,610,000 eggs, and from them 200,680,000 fry were hatched.

The haddock fishing season began several weeks later than usual, causing an unusually short egg-collecting period. Between April 12 and May 5, 36,720,000 eggs were secured from the gill-net fisheries off Cape Ann, which number produced 22,170,000 fry for distribution.

The scarcity of egg-bearing lobsters within the reach of the Gloucester station and the unfavorable conditions attending the collection of brood lobsters and their eggs have had the effect of practically suspending lobster hatching at this point. In the fall of 1915 an experimental lot of 21 egg-bearing lobsters was purchased and placed in a live car to be carried through the winter. When removed therefrom about the middle of May, only 16 specimens were alive. These yielded 210,000 eggs, which, with 320,000 additional eggs purchased during the spring, represented the entire supply of the hatchery.

In view of the small results attained at the Woods Hole station in recent years in collecting cod eggs from the fishermen operating in Cape Cod Bay, it was decided to discontinue the operations there and rely solely upon brood cod obtained from commercial fishermen. Arrangements were accordingly made to prosecute this work on an extended scale, and the spawning inclosure provided for the purpose was stocked during November with 3,100 brood fish, a larger number by 700 than had heretofore been held therein. The fish were of exceptionally fine quality and the mortality was negligible. Eggs

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were obtained from the inclosure between December 1 and February 16, the spawning season beginning about the usual time but closing fully a month earlier than in 1915. Of the total collection of eggs, amounting to 286,056,000, only 265, 877,000 could be handled with the available hatching facilities. The remainder were therefore transferred to the Gloucester station. The incubation of the eggs proceeded favorably except for occasional periods of roily water, at which times some losses were sustained, owing to the inability to keep the hatching boxes working properly. The final results were 192,275,000 fry, which were liberated in local waters.

The first brood flatfish of the season at Woods Hole were purchased from commercial fishermen on January 12, but, having been taken from deep water, their eggs were not sufficiently developed to mature satisfactorily in confinement. The fish were therefore released later in the season to provide room for more advanced stock. Brood flatfish were secured as heretofore from the grounds at Waquoit and Wickford and from the newly established field at Menemsha Pond, 12 miles distant from the Woods Hole station. Between January 18 and the end of March, 1,099,622,000 eggs were secured, and had there been facilities for handling them it is believed several billions of eggs might have been obtained from the fish in sight at Menemsha Pond. The fry hatched numbered 748,560,000, the percentage of loss in incubation being larger than last year, owing to the difficulty experienced at times with roily water.

RESCUE OF FISHES FROM OVERFLOWED LANDS.

The usual work of rescuing food fishes from the overflowed lands along the Mississippi and Illinois Rivers, by seining crews sent out from the regular stations and by special field parties, was conducted at Homer, Minn.; La Crosse, Wis.; North McGregor, Iowa; Bellevue, Iowa; Friar Point, Miss.; and Meredosia, Ill. Water stages on the upper river were so high during summer that no work could be accomplished until August 25. The total collections were larger than for many years, 11,682,064 valuable fishes being rescued. Of this number, 1,179,862 were delivered by cars and messengers to applicants or for planting in distant public and private waters; the remainder (10,502,202) were returned to the Mississippi River.

A most conspicuous public service was rendered in March and April by the rescue of some 5,000,000 large fingerling and adult fish, buffalofish and carp predominating. These were taken from an overflowed area 11,000 acres in extent, across the Illinois River from the Bureau's station at Meredosia, Ill. The preceding year fish dealers in that vicinity had impounded several thousand adult fish in a large lake back of the levees protecting the district. Subsequent rains inundated the entire area, scattering the breeding fish far and wide during the spawning season; and as the water receded their offspring, being unable to escape to the river, became congested in unbelievable numbers in drainage ditches and depressions of the land. Their total loss would have been inevitable had it not been for the prompt action of the Bureau in conducting rescue operations so long as funds were available. The majority of the stranded fish were thus saved, and their return to the Illinois River must serve to add materially to the resources of that stream in years to come. It is

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the desire of the Bureau to secure adequate funds for increasing this work throughout the Mississippi Valley, as the present operations are wholly incommensurate with the field to be covered. Buffalo-fishes, carp, and catfishes, the mainstay of the commercial fisheries there, are noticeably decreasing, although sufficient young of these species are each year perishing on the overflowed lands to maintain the present fisheries and increase the future supply if proper measures for their salvage are taken.

ACCLIMATIZATION.

The transfer of humpback-salmon eggs from the Pacific coast to the Maine hatcheries was repeated in the fall of 1915, and in the spring of 1916 the third plant of the species was made in the waters of that State, which were at one time replete with the Atlantic salmon. The young available for distribution, numbering 6,225,808 and ranging from 2½ to 6 inches in length, were deposited in previously selected streams under very favorable conditions.

The success of this interesting experiment in acclimatization seems assured. There was a remarkable return of mature fish in the summer and fall of 1915, the outcome of plants made in the spring of 1914. Many fish weighing over 5 pounds were taken or seen in the Penobscot River, and 20 were captured alive by agents of the Bureau near Bangor and held in an effort to obtain ripe eggs. From two of these fish 3,000 eggs were taken on September 6 and, after fertilization, sent to Craig Brook, where incubation was completed with normal results. Accounts of the appearance of this new fish in various minor rivers have come in, and in the Dennys River there was a noteworthy run which began as early as August 15 and continued as late as September 24. The local fishermen caught and ate large numbers, and during the week of September 20 an employee of the Green Lake hatchery took 15 fish (8 males and 7 females) which had passed through the fishways in dams in Dennys River and were dropping downstream in a spent condition. At the same time both live and dead fish were observed below the dams.

Another carload lot of Atlantic lobsters from Maine was sent to the Pacific coast on November 15, 1915. The shipment, consisting of 5,423 adults about equally apportioned as to sex, reached its destination on November 20 in much better condition than any previous lot. At the railroad terminus (Anacortes, Wash.) the lobsters were placed in four floating live cars that had been prepared for them, and there allowed to feed and to recuperate overnight. The following morning they were towed in the crates to the San Juan Islands, in Puget Sound, and liberated in Bellingham Channel, off Guemes Island. The number of strong, healthy lobsters planted was 3,325, or over 61 per cent of the original consignment.

During the fall of 1915 a shipment of large crabs from Puget Sound to the New England coast was made. Owing partly to a wreck and partly to difficulties in handling, only a small number survived the journey. These were liberated in good condition off the coast of Maine.

Limited consignments of fish, lobsters, and fish eggs to foreign countries and insular possessions were made during the year. Fifty thousand rainbow-trout eggs were sent to Portugal, 200 adult

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lobsters to Japan, and 600 black bass, 1,500 sunfish, and 1,500 catfish to Porto Rico.

COOPERATION WITH THE STATES.

The Bureau has been glad to continue its usual cooperative relations with State fishery authorities, and has furnished on request large numbers of eggs of various species for development in State fish hatcheries and also considerable numbers of young fish for planting under State supervision. A list of the States to which such assistance was rendered, and the allotment of fish or eggs in each case, are shown by the following table:

ALLOTMENTS OF FISH AND EGGS TO STATE FISH COMMISSIONS, FISCAL YEAR 1916.

State and species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Alabama: Black bass			1,000
California: Chinook salmon	19,622,340		
Colorado:			
Blackspotted trout	160,000		
Brook trout			1,500
Delaware:			
Black bass			375
Shad		400,000	
Illinois:			
Black bass			5,040
Brook trout	25,000		300
Carp			249,000
Catfish			62,900
Crappie			35,390
Pickerel			560
Pike perch	20,000,000		
Rainbow trout	50,000		9,750
Sunfish			6,240
Yellow perch			1,600
Indiana: Pike perch	15,000,000		
Iowa: Pike perch	25,000,000		
Kentucky:			
Pike perch		9,600,000	
Rainbow trout			16,000
Smallmouth black bass		7,500	
Maine:			
Brook trout	100,000		
Lake trout	50,000		
Landlocked salmon	300,000		
Maryland: Brook trout	50,000		
Massachusetts:			
Pike perch	25,000,000		
Shad	1,097,000		
Yellow perch	15,000,000		
Michigan:			
Lake trout	3,000,000		
Landlocked salmon	25,000		
Pike perch	26,235,000		
Smelt	10,000,000		
Minnesota:			
Lake trout	200,000		
Landlocked salmon	25,000		
Steelhead trout	250,000		
Montana:			
Blackspotted trout	200,000		
Brook trout	50,000		
Catfish			940
Grayling	2,300,000		
Pickerel			565
Rainbow trout	320,000		
Sunfish			625
Yellow perch			475
Nebraska: Pike perch	1,500,000		
New Hampshire:			
Brook trout	50,000		
Lake trout	100,000		
Landlocked salmon	25,000		
Rainbow trout	100,000		
Steelhead trout	93,000		

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ALLOTMENTS OF FISH AND EGGS TO STATE FISH COMMISSIONS, FISCAL YEAR 1916—Continued.

State and species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
New Jersey:			
Landlocked salmon	10,000		
Rainbow trout	50,000		
Smallmouth black bass			159
Steelhead trout	93,000		
Yellow perch	10,000,000		
New York: Landlocked salmon	25,000		
North Dakota:			
Pike perch	6,000,000		
Steelhead trout	93,000		
Ohio:			
Pike perch	68,425,000		
Whitefish	68,640,000		
Oregon:			
Blackspotted trout	200,000		
Blueback salmon	3,000,000		
Chinook salmon	1,000,000		
Silver salmon	196,000		
Steelhead trout		500,000	
Pennsylvania:			
Lake trout	100,000		
Pike perch	3,000,000		
South Dakota:			
Brook trout			50,000
Loch Leven trout			30,000
Pike perch	25,000,000		
Utah:			
Brook trout	100,000		6,000
Lake trout	50,000		
Vermont:			
Catfish			150
Lake trout	201,054		
Landlocked salmon	50,000		
Smelt	15,000,000		
Steelhead trout	150,000		
Washington:			
Brook trout	50,000		
Blackspotted trout	432,000		
Rainbow trout	100,000		
Wisconsin:			
Lake trout	3,500,000		
Whitefish	5,000,000		
Wyoming:			
Blackspotted trout	200,000		
Brook trout	50,000		
Grayling	400,000		
Lake trout	25,000		
Rainbow trout	100,000		
Steelhead trout	200,000		
Total	377,367,394	10,507,500	478,569

FISHES PLANTED IN CONNECTION WITH FISH-CULTURAL EXPERIMENTAL WORK.

The fisheries biological station at Fairport, Iowa, engages not only in mussel propagation, but in experiments relating to the propagation and rearing of useful fishes. The experiments are conducted not for the purpose of distribution, but for the acquisition of knowledge of practical value in fish culture. Nevertheless, large numbers of fish are produced, and the surplus is liberated in the public waters, usually in the vicinity of Fairport, and in connection with operations of mussel propagation. The following table shows the number of each species distributed and the stage in which planted. These figures are not included in the report of regular distributions elsewhere referred to.

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FISHES DISTRIBUTED AND STAGE IN WHICH PLANTED.

Species.	Fry.	Fingerling.	Adult.	Total.
Largemouth black bass		5,332		5,332
Smallmouth black bass	4,500	719		5,219
Sunfish		54,723	419	55,142
Crappie		5,335	4	5,339
Buffalofish	9,911,250	24,350		9,935,600
Catfish		2,657	144	2,801
Missouri sucker	83,000			83,000
Total	9,998,750	93,116	567	10,092,433

ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS.

The propagation of fresh-water mussels is pursued in connection with the operations of the fisheries biological station at Fairport, Iowa, chiefly through field parties at various places in the Mississippi Basin. The object of this work is the increase of the mussels whose shells are utilized in the extensive pearl-button industry.

During the year the inoculation of fishes with the larval mussels, which is the only known method of propagation, was actively continued, and increased efficiency is to be noted. Owing to exceptionally high and prolonged flood stages of the central rivers, it was impossible at times to accomplish the best results, and the number of larval mussels planted was, therefore, slightly less than in the preceding year, being 331,451,490, compared with over 344,000,000 in 1915. These belonged to seven species of commercial mussels, as shown in the following table. The actual cost of production was 1.55 cents per thousand, but if allowance is made for overhead charges the cost per thousand was 2.35 cents, against 2.7 cents in 1915. In connection with this work, 34,772 adult and 265,462 fingerling fish were rescued from landlocked ponds in the overflowed lands and returned to public waters. The total number of fish handled was 424,550.

MUSSEL PROPAGATION, FISCAL YEAR 1916: POINTS OF DEPOSIT AND SPECIES OF GLOCHIDIA USED FOR INFECTION.

Species	Mississippi River.		Wabash River: Vincennes, Ind.	Black River: Black Rock, Ark., and south.	White River: Newport, Ark., and vicinity.	Total.
	Fairport, Iowa.	Lake Pepin, Minn.				
Black sand-shell (*Lampsilis recta*)	11,288,300					11,288,300
Butterfly (*Plagiola securis*)	415,800				411,800	827,600
Lake Pepin mucket (*Lampsilis luteola*)	20,990	151,175,000				151,195,990
Mucket (*Lampsilis ligamentina*)	73,043,500		3,553,500	26,711,100	63,928,300	167,236,400
Blue-point (*Quadrula plicata*)	147,000					147,000
Pocketbook (*Lampsilis ventricosa*)	447,000					447,000
Yellow sand-shell (*Lampsilis anodontoides*)	309,200					309,200
Total	85,671,790	151,175,000	3,553,500	26,711,100	64,340,100	331,451,490

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MARINE AND FRESH-WATER INVESTIGATIONS, SURVEYS, AND EXPERIMENTS.

STUDIES OF MARINE FISHES.

Notwithstanding the long existence of great marine fisheries and the common assumption of their inexhaustibility, the development of modern fisheries has been such as to call for the artificial propagation of certain species and to create a demand for knowledge of the life histories, the habits, and the migrations of the important fishes. This knowledge is desired in order that we may determine with what impunity the fishing methods may be continually increased in extent and thoroughness, or what measures of protection may be appropriate, and so that we may properly appraise the value and the possibilities of cultural operations as applied to marine species. The problem must be approached through a complex but systematic plan of study, and final results are not obtainable in a short time. Nevertheless, the continued collecting of fishes at various places and in the different seasons, the persistent application of the methods of modern science to the details of structure that may be characteristic of different localities or ages or seasons or that may be indicative of migrations or other phenomena of life, and the careful consideration of the conditions and results of commercial fisheries will bring us finally to the attainment of a degree of precise knowledge that a few years ago we could not have anticipated.

The investigation of the sea herring, which, as the basis of the herring and sardine industries, is one of the most important fishes of the North Atlantic coast, has been continued in connection with the oceanographic work of the schooner *Grampus*. The analysis of the data gathered has been pushed as rapidly as possible and it is expected that the results will be ready for publication within a short time.

The most important commercial fish of the South Atlantic and Gulf seaboard is the mullet. Careful studies pursued through temporary services in connection with the Beaufort laboratory have laid a definite and necessary basis for more comprehensive inquiries when it may be possible to carry them out. It is expected that a detailed report of the result of the studies can be published after the conclusion of one more season's work.

An investigation of the habits and possible races of flounders has also been undertaken on the coast of New England, but as the study is only in its incipiency and the investigator has not yet been able to devote to it his entire time it is not now possible to report a definite degree of progress.

For several years the Bureau has directed attention to the condition of the tuna fishery on the coast of southern California, which, with the canning industry based upon it, has shown such marked development in the last few years. The fishery and canning industries are subject to unfortunate vicissitudes because of the irregular appearance of the tuna in the waters accessible by the present methods of fishery. Nothing of a definite nature has been known as to the habits of the tuna, the causes that govern their appearance and disappearance, the parts of the ocean generally frequented by them, or the localities resorted to for purposes of breeding. For nearly two years the Bureau has attempted to gain such information as was

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obtainable through investigations conducted from shore or by the use of small boats. It was realized that the proper method of attack was through investigations extending over a large area of the ocean and conducted through the instrumentality of a seagoing vessel. This was fortunately made possible in February, 1916, when Congress through an urgent deficiency bill provided an appropriation which enabled the Bureau to detail the steamer *Albatross* for special service in the tuna investigation. The first cruise was promptly begun, and on May 10 the vessel arrived at San Diego after spending three weeks in cruising along the coast of Lower California and several hundred miles farther south and west, as far as Los Coronados Islands. Other cruises followed this one, and the investigation was in progress as the fiscal year closed. From the middle of April to the middle of May there were no tuna along the Lower California peninsula from San Diego to Socorro Island and westward to Guadalupe Island. Two of the best practical tuna fishermen of San Diego accompanied the vessel on this cruise. In the latter part of May tuna were encountered off Lower California near San Geronimo Island, and near the San Benito Islands; none were found on a cruise extending west of San Diego 150 miles. During the month of June tuna were present off San Diego and San Pedro, although they were not taken in commercial quantities, this being attributed to the coldness of the surface water. The investigation has been somewhat hampered by the continued prevalence of rough weather, but will be continued and prosecuted as actively as possible during the next fiscal year.

The importance of a knowledge of the larval development of fishes was cited in the last annual report. Such studies have been continued both at the Woods Hole laboratory and in connection with the investigations in Chesapeake Bay. At the Woods Hole laboratory substantial information was gained regarding 12 species, 6 of which are of direct commercial importance, namely, the tautog, cunner, scup, sea robin, whiting, butterfish, anchovy, menhaden, glut herring, silverside, three-spined stickleback, and four-spined stickleback. For years the Bureau has endeavored to gain information regarding the breeding habits of the menhaden. With the knowledge gathered during the present fiscal year, the Bureau is now in better position to follow up the life history of the menhaden.

Near the close of the fiscal year and in connection with the Chesapeake Bay investigations, additional data were obtained regarding the eggs and larvæ of the anchovy, hog choker, goosefish, and gray trout (squeteague). Experiments with hatching of butterfish were attended with success.

SHELLFISH INVESTIGATIONS.

The oyster, as the most important food resource of our waters, has continued to command such attention as it was possible for the Bureau to bestow. Owing to the fact that oyster culture, where it is now practiced, has reached a relatively advanced stage of development and, where not practiced, is hindered by peculiar economic conditions, the problems of the industry are comparatively complex and difficult of solution. Until the close of the fiscal year 1916 the Bureau had not been in position to give the continued and effective attention to the oyster that it deserved. Recent action by Congress has to a large extent remedied this deficiency and more effective serv-

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ice to the oyster fishery may be expected in the future. This has been brought about by the establishment of several new positions carrying salaries that will attract and retain competent assistants.

Meantime the Bureau has sought to attack such problems of oyster culture as were adapted to its means and facilities. Encouraging progress has been made in studies of the propagation of oysters, the nutrition of oysters, and the occurrence of phenomena of "greening" and "green gill." In the study of "green gill" the results have been of unusual interest and value. While no method of controlling the "green gill" has been determined, it seems well established that the green color is due to the presence of a particular diatom, one of the minute floating plants that form a large element of the food supply of oysters. This particular species of diatom is known as *Navicula ostrearia*, and is identical with the form which is abundant in the region of Marennes, France, and which gives to the oysters of that region the peculiar color and flavor which are so highly esteemed. It is not yet ascertained what are the causes of the peculiar abundance of this form in certain years and in certain localities, but when it is known to the public that the occurrence of "green gill" merely means that the oysters have attained a condition that is so highly esteemed in the markets of Europe much should be done to dispel the present prejudice which occasionally causes great financial loss to our planters. Instead of being dreaded or a cause of pecuniary loss, the "green gill" may be welcomed as giving the opportunity to supply a superior article at perhaps a premium in price. These statements do not apply to the oysters which are marked by greening of the entire body owing to the presence of certain mineral salts in the water. This is a distinct condition not easily confused with the well-known "green gill."

The problems of oyster culture on the Pacific coast, where an industry of great possibilities is contending against peculiar natural difficulties, have received recognition, although not as yet in a manner commensurate with the actual needs. Some support has been given to investigations being pursued in Puget Sound, and the progress attained has been such as to justify the Bureau at the close of the fiscal year in arranging to extend a substantially increased measure of financial aid.

The remarkable growth of the blue-crab fishery during recent years has made protective action seem imperative, and the Bureau has been repeatedly importuned for counsel as to the propriety and effectiveness of specific measures proposed and for information regarding the habits and life history of the crab. Since the blue crab is migratory, passing at different stages of its life cycle from the waters of one State into those of another and going from the bays to the ocean and back, the Federal Government is the only agency which can properly and effectively complete the necessary investigations. The result of careful attention to the matter has been to perfect before the close of the year an arrangement under which competent services are secured for attacking the study in a thorough manner.

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PROGRESS OF DIAMOND-BACK TERRAPIN CULTURE.

The success which has previously been attained in the experiments in terrapin culture has been continued in the past year in even more marked degree. It is timely to summarize some of the more important results at the Beaufort laboratory.

(1) Perhaps the most interesting development of the year is the fact that the three oldest broods of terrapin that were hatched in the experimental pounds and grown in captivity have produced eggs. The two oldest broods, one of which had been winter-fed during the first season while the other had been permitted to hibernate, began laying in 1915 and the eggs hatched successfully. The terrapin of the hatch of 1911 laid eggs in 1916, before the close of the fiscal year. These significant inferences may be made: (*a*) That terrapin born and reared in confinement develop in a normal way and will reproduce their kind; (*b*) that the reproductive cycle may be completed in six years, even though the terrapin hibernate as in nature; (*c*) that by preventing hibernation and forcing growth through the first winter by feeding in a heated house the maturity as well as the growth of the terrapin may be advanced by one year, so that a new generation is started in five years rather than in six.

(2) The adult breeding stock of terrapin has from year to year steadily increased in productivity, and there is ground for belief that the adult breeders have not yet reached the maximum capacity for reproduction. The following figures show the number of young produced by adult breeders during each of the past four years and also the average number per female yielded by the original stock of breeders:

Year.	Number of young from all adult breeders.	Average number per female of original breeding stock.
1912	1,326	12.81
1913	1,506	14.52
1914	1,690	15.23
1915	2,128	21.43

Those terrapin which have been longest in captivity produced in 1915 an average of 21.43 young for each female.

(3) The value of winter feeding during the first season is well established by the increased rate of growth, the shortening of the time required to attain reproductive maturity, and the very low rate of mortality. The death rate has never been so low as during the winter of 1915–16. Among 700 terrapin fed on fresh food the loss was about 6½ per cent, while among those fed on salted food the loss was about 8⅓ per cent. The death rate in hibernating stock was 13 per cent. The cost of food for winter feeding at Beaufort varies from 3 to 15 cents per 1,000 young terrapin per day, according as salt fish, fresh fish, or oysters are used. Assuming 10 cents as an average daily expenditure per 1,000 terrapin, the cost of food for 1 terrapin for a period of 5 months in the first winter would be 1½ cents.

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(4) The death rate among terrapin after the first season is so small as to be nearly negligible. It is found to be about 1 per cent in the second year, diminishing with age to one-half per cent and less. The principal mortality occurs in the first season, and is then found to be chiefly among the "runts," which should probably be culled out in ordinary practice. While the death rate has been as high as 20 to 25 per cent during the first season, it has now been reduced, partly through improved methods of sanitation, to less than 10 per cent. The losses are remarkably low when it is considered that deaths occur principally when terrapin are very young and before they have become a source of expense, and that the productivity of the terrapin is such that even a loss of 30 per cent at this stage could readily be compensated for by increasing the numbers hatched and saved for rearing. So far as regards disease and death rate the rearing of terrapin is a matter of much less difficulty than the raising of poultry.

(5) The history of our experiments during many years gives strong grounds for belief that domestication of terrapin is accompanied by increasing productivity and diminishing disease and mortality. Our experience indicates the advisability of retaining a select brood stock for a rather indefinite period, instead of adopting new breeders from year to year, as might be done in stock raising. Some of the breeders have been in captivity for about 14 years.

It may be noted that the experiments in terrapin culture have not the nature of small laboratory tests but are carried out upon such a scale as to be comparable to commercial operations. It is possible also to check our results against those obtainable in a large local commercial venture which has adopted methods based upon those followed in the Bureau's work. From this it appears that the various results gained in the Bureau's experimental work are not to be taken as exceptional, but that they are, in a general way, typical of what may be expected in cultural operations conducted according to sound principles and with the exercise of proper care.

There are now about 3,000 terrapins under observation and classified in more than 25 experiments which are being directed to obtain definite answers to practical questions that yet demand attention and justify the continuance of the investigations. Among these are: What is the proper proportion to maintain between males and females, and what are the best conditions for prolificness in eggs and for successful hatching? What are the possibilities of improving rate of growth by selection, and what are the opportunities for promoting economy through proper culling or other methods? These are only some of the practical questions which warrant further investigations.

SURVEYS OF FISHING GROUNDS.

Some further work has been done in extending the known limits of the blackfish grounds off the coast of North Carolina. The Bureau maintains a buoy on the principal grounds, which is of service to fishermen both in locating this particular ground and as a bearing from which to find other grounds. The fishery is not developed in proportion to the evident possibilities, owing partly to the lack of suitable boats and partly to the unwillingness of local fishermen to engage in operations at any distance from the shore. One or two crews have, however, taken advantage of the opportunities and the

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fishery was regularly followed through the winter and spring of 1915–16 with results that were very satisfactory to the fishermen and the vessel owners.

The survey of halibut grounds lying off the coasts of Oregon and Washington was continued by the steamer *Albatross* during the first three months of the fiscal year. The first trip of the *Albatross* was to grounds off the coast of Washington from Grays Harbor to Flattery Banks, but the abundance of ground and blue sharks rendered the location unpromising for the establishment of a fishery at that time. Two especially favorable halibut bottoms were discovered, one 31 miles west of Grays Harbor and the other 37 miles S. by W. from the Umatilla Lightship.

The second trip covered the same region by lines of sounding intended to determine the possible existence of offshore banks rising from the deep water. One such bank was located as apparently the top of a submerged mountain, rising 6,000 feet from the floor of the ocean. The depth ranged from 525 to over 830 fathoms. The bank is not shoal enough for fishing, but it suggests the possible existence of other banks that might be of greater practical importance. The location of the bank is about 278 miles from Cape Flattery Light, the latter bearing N. 66° E.

A third trip covered the region off the Columbia River and south therefrom as far as Cape Meares. Good halibut bottom was found S. 71° W. of Columbia River Lightship, 17 miles out. South along the 100-fathom curve to Cascade Head good bottom was noted for nearly the entire distance in 110 to 120 fathoms. A patch of suitable bottom was located 22 miles northwest of Cape Meares Light in 94 fathoms. The largest ground discovered by the *Albatross* on this trip lies between Tillamook Head and Cape Falcon, 28 to 30 miles from the coast. The bottom is of coarse and fine gravel, black sand, and granular shale, and an abundance of life was noted at the surface of the water. Important hydrographic observations were made and reported to the Coast and Geodetic Survey and to the Navy Department. A report of the halibut survey, with charts, will soon be published.

OCEANOGRAPHIC STUDIES.

If we were interested to know the capacity of certain lands for the support of particular kinds of animals; if we wished to ascertain the causes of the natural movements of such animals; or if we were to determine upon a proper policy of handling our stock in governance of their capture, or in endeavors to increase their numbers by cultural methods, we could not neglect to consider the character of the land in its various parts, its yield in vegetation small and large.

Similar inquiries, roughly speaking, when applied to the ocean constitute the science of oceanography. However it may appear to the eye, the ocean is not one great homogeneous body of water, but is marked by a diversity such as we are familiar with upon the land. Variations in depth, in saltness, in temperature, or in richness of animal and plant life are always encounterable, whether we proceed from the shores to the open sea, from the surface to the bottom, from east to west or north to south, from any one geographic region to another. There are variations from year to year, even from season to season; there exist veritable deserts where abundant fish might

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starve from want of food, contrasted with zones of plenty. There are currents and counter currents and blendings of different waters. In one geographic locality, waters flowing from tropical regions and laden with characteristic animals and plants may overlie waters emanating from arctic domains and carrying their peculiar types of living things. If we do not have knowledge of such conditions, we can not determine whether a condition of extreme paucity of fish life such as was conspicuous on our eastern shores in the summer of 1916 is an indication of exhaustion of the fisheries or is an inevitable consequence of observable oceanographic abnormalities that can not be affected by man's operations; we will not be able to understand what general movements of fishes or variations in local abundance of fishes are attributable to unwise human operations and what are properly to be expected as a reflection of normal phenomena of nature.

Oceanographic studies are not new in this or other countries; and extensive data have been gained by the Bureau at various times during many years, but within the past few years the Bureau has planned for better coordination of such studies as could be conducted within its means. Operations have been pursued intensively in restricted regions, so that a completed exploration might be made and relations established with a degree of definiteness that would make it possible to deduce some practical conclusions.

The investigation of waters off the Atlantic coast, primarily in the Gulf of Maine and southward to the Grand Banks, has been continued in connection with studies of the life history and habits of the herring and other fishes. The schooner *Grampus* was detailed to this work with an assistant from the office in active charge of the observations, while the investigation was under the fortunate direction of a skilled oceanographer whose services were available to the Bureau. The results gained during preceding years have been made public from time to time and a final report may be expected within a short while.

Near as the Chesapeake Bay is to the center of administration and important as its fisheries are, we have been without systematic and detailed knowledge of the physical and biological features of its waters and of the effect of such conditions upon the constant movements and varying abundance of important fishes. Beginning in October, 1915, the steamer *Fish Hawk* was detailed to a general investigation of the Chesapeake Bay under the direction of a well-equipped assistant. At intervals of a month or six weeks there have been cruises over the bay, while observations of various sorts were made and material collected for later careful study. The investigation was by no means confined to technically oceanographic subjects, but a number of useful inquiries were embraced in the general scope of work and many valuable services rendered. The existence of resources in hydroids, or "sea moss," the basis of a possible new industry was demonstrated; the spawning habits and the life histories of fishes were studied; experiments were made with the propagation of certain species; crab fishermen were induced to experiment successfully with use of pickled dogfish and shark meat as bait, and a probable use established for a fishery product that had hitherto been wasted. The United States National Museum, upon invitation from this Bureau, also took advantage of an unusual opportunity to add to its natural history collections. The survey must be ex-

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tended into the next fiscal year before it can reach a stage of completion.

Each important vessel, where engaged in other primary investigations, has taken advantage of the opportunities for recording hydrographic observations as far as consistent with the economical prosecution of its immediate objects. Thus data of some value have been reported by the steamer *Albatross* while pursuing special studies of the western coast and by the steamer *Fish Hawk* while working off the coast of North Carolina.

STUDIES OF ANADROMOUS FISHES.

Among the most highly esteemed of our food fishes are those that spend the greater part of their lives in the ocean, but at one stage enter the rivers for the purpose of reproduction. Such are the salmons, the striped bass, the shad, and the sturgeons. Crowding as they do at one particular season into certain restricted channels, namely, the river courses of our coastal slopes, they become the more readily an easy prey to man's pursuit. Unless the greatest foresight and restraint are exercised in the fishery, and the methods of artificial propagation are resorted to, such fishes are certainly doomed to rapid diminution, if not complete disappearance. The absolute abundance of anadromous fishes is too easily overestimated. Take all the shad which even in past times entered our rivers and strew them widely over both land and water of the coastal plain, and their "abundance" would be lost to view; or, as may indeed be done in nature, scatter them over the continental slope beneath the ocean waters and they become one of the rarer fishes of the sea. There is little reason to wonder that a shad is so seldom taken in the ocean fishery followed off the greater portion of our coast. It would have to be an extraordinary condition, such as abundant food, perhaps, that would bring shad together in a particular region of the sea, that would permit an ocean fishery for shad to be carried on. Such, indeed, appears to be the case of certain regions off the northeastern coast where "sea-run shad" become a feature of the local markets. What is the origin of such shad? Are they a distinct race, or are these the shad that were bred in southern rivers? The extent and directions of migration of the fish are questions of vital interest. To what extent are the runs of one river affected by fishing operations in another? In what degree does artificial propagation in one stream yield returns of value to another? These are all kindred questions or aspects of one general problem for each anadromous species.

Notwithstanding the attention which has been devoted to the shad during so many years, the paucity of explicit knowledge is keenly felt. Early in the fiscal year the Bureau instituted a comprehensive investigation of the shad, hoping that the application of newer methods of investigation may afford the key by which the mysteries may be unlocked. Beginning with the St. Johns River in Florida in January, the investigator has worked up the coast, visiting the principal shad streams as nearly as possible at the time when the fish are arriving from the sea. By the close of the fiscal year he had reached New England, where studies were being made both of the native shad of Maine and the sea shad of the waters north of Cape Cod. Many questions have received attention,

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although the primary purposes have been to determine if shad of different rivers or of different brood regions present distinguishable racial differences and to obtain information as to the extent of the coastwise movements of the fish. Many data have been accumulated and many specimens secured, all of which must form the basis of subsequent detailed studies before exact conclusions can be drawn.

Associated with the shad and herring and having similar habits is the glut herring, a species of considerable abundance but one which until recently found only a limited market in the localities in which taken. The past few years have witnessed a marked increase in value and diminution in numbers. During the past season experiments were made by an assistant in cooperation with fish culturists to ascertain the best methods of handling and hatching the eggs, and the results have indicated that the artificial propagation of the species on a large scale is feasible.

The detailed study of the life history of the salmon of the Sacramento and Columbia Rivers has been continued and the field work is practically concluded. With the study of accumulated data and the preparation of the report during the ensuing fiscal year, it is expected that conclusions will be reached that will guide our fish-cultural operations to a stage of greater efficiency. In the direction of these studies the investigator has had not only the benefit of the most expert counsel but the sympathy and suggestions of practical fish culturists.

INVESTIGATIONS RELATING TO FRESH-WATER FISHES.

The field of fresh-water fish investigations has been too little touched, although the immediate opportunities of domestic fish culture are probably greatest among fresh-water forms. No one assumes that the great complex of streams and abundant lakes and ponds are productive to their maximum capacity, but rarely is due care taken to conserve in practicable ways the conditions in them favorable to the growth and propagation of fish. This phase of the general problem of fish production is not yet adequately realized nor are the principles satisfactorily developed.

That the streams, lakes, and ponds should be stocked and restocked with fish is an ever growing demand which indicates the widespread interest in such fisheries, whether they serve as a means of recreation or as a source of food. The stocking and restocking of waters is, however, not usually the principal desideratum. In specific instances the actual condition to be relieved may be due to an overabundant stock. Just as agriculture has long since passed the stage where increased production is sought primarily through the planting of more seed in a given area, so it is incumbent to give proper attention to promoting a favorable condition for the growth of fish, looking intelligently to the maintenance of suitable condition of physical environment, abundance of food, proper association of species, and a correct proportioning of numbers and variety of fishes to the biological capacity of the water.

The fishery problems of fresh water are undoubtedly simpler than those of the seas, but they are certainly less directly approachable than the problems of agriculture which have met their solutions. It is not surprising, therefore, that, throughout the country in mat-

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ters of fish culture, there is as yet too little serious endeavor to find real causes or to apply appropriate remedies. Year by year the Bureau is devoting more careful and fitting attention to the problems of fresh-water fisheries, and some of its principal activities in this field may be referred to.

The problem of fish culture, at least as referring to pond fishes, is primarily one of food supply. Our knowledge of the food of fishes is as yet seriously inadequate. The food taken by fishes varies with the species, with size and age of the fish, with the season of the year, and with the abundance of the various kinds of food materials present in different bodies of water. A few observations in one locality or at one season of the year afford no criterion for the conclusions that we may seek to draw, for an appraisal of the possibilities of fish production in any body of water, for an understanding of the variations in the sizes attained by a given species of fish in different bodies of water, and for the direction of our efforts to promote an abundent and reasonably constant supply of food under all conditions subject to control.

One of the investigations of the food of fishes that has been pursued comprises an examination of a number of perch taken from each of two lakes in Wisconsin during each week in the year. At the same time collateral studies have been made of the food of many of the important fishes, their habits and interrelations. Some of the results have been submitted for publication, while other reports are in preparation. The accumulation of such data is not of theoretical interest; it is indispensable to a purpose, for it must lead eventually to intelligent conclusions as to the highest possibilities in rearing fishes and the methods of realizing such possibilities.

At the Fairport station several special fish-food studies are being actively pursued. In connection with the experiments in rearing buffalofishes, examinations are systematically made to determine the food taken at all sizes and all stages. Investigation of the food of all small fishes in the experimental ponds are being conducted in connection with parallel studies of the available foods in the ponds. Systematic studies are being made of the aquatic insect life. Experiments are also being directed at the problem of promoting an abundant growth of food organisms by methods of fertilizing the water or otherwise.

The investigation of the habits and movements of fishes in the Mississippi River with especial reference to the obstruction of the river by the dam at Keokuk has been continued throughout the fiscal year. Only tentative conclusions have as yet been reached, but the progress of the investigation has been such that it may be hoped to present a full report within another year.

Within the year there has been completed a report embodying the results of an earlier investigation of the Rangeley Lakes of Maine. These have for many years been among the more widely known for their game fishes, and the investigation was undertaken to gain information that might serve not only as a guide to fish-cultural development of these particular waters but as a basis for the adoption of a proper policy with regard to other lakes. The report comprises an unusual body of information regarding the habits and relations of many important food and game fishes.

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There is in progress and now drawing to a conclusion an investigation of the habits of the common smelt, a fish which is of no little economic importance, partly as an object of fishery itself and more significantly as a source of food for the larger food and game fishes.

It is generally known that many species of fish are destructive to the larvæ of mosquitoes, but, where public health is involved, it becomes of high importance to know definitely what fish are most effective in mosquito extermination and under what conditions is their efficiency greatest. In many cases, where the usual treatments of waters are impracticable because of expense or other sacrifice involved, it is convenient to rely upon the agency of small fish, provided there can be assurance that the result sought will be fully accomplished. It is possible that in particular cases partial failure to eliminate all mosquito larvæ can be turned into complete success through the introduction of other kinds of fishes that will be adapted to the particular condition of the pond or through measures taken to so change those conditions that the fish will have a better chance to obtain their prey. It is necessary then to study the comparative efficiency of the different species of fish and to ascertain how the efficiency of the more suitable species is affected by the various conditions of depth, vegetation, and débris.

At the beginning of the fiscal year the Bureau issued an economic circular giving an account of the various species of fish that play an important part in mosquito extermination and at the same time it entered into cooperation with the Bureau of Entomology for a careful investigation directed to the ends just stated. The inquiry will be continued through the next fiscal year.

In addition to its functions in mussel culture, and without hindrance to them, the Fairport station is being utilized effectively in fish-cultural experimental work. Some of these experiments are being conducted with the game fishes that are favorite objects of cultural efforts. The purpose of these experiments is primarily to ascertain the conditions under which the fish may be reared to a market size in greatest numbers.

During the spring of 1915 unusual success was attained in the hatching of the eggs of the buffalofish after artificial fertilization. A number of the fry were placed in a new station pond to be kept under observation. Notwithstanding the raw state of the pond and other unfavorable conditions, more than 25 per cent of the fish, or about 45,000, were found to have survived when the pond was drawn in the fall, and some had attained a length of over 6 inches. A good many of the fingerlings were liberated and others were retained for further growth. A proportion of loss was experienced during the winter season, but the experiments are still in progress. Not all has been obtained that would be desired, but, as the first attempt at rearing buffalofish in capitivity, the success is such as to recommend the continued experimentation with a form that is well known as a commercial food fish of large size and of diminishing abundance.

Quite interesting results have been attained too with the channel catfish (*Ictalurus punctatus*), a form that has hitherto baffled all attempts at propagation. Just at the close of the fiscal year the first successful attempt at propagation was in progress, but the further history of the experiment is a matter for a later report.

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The Bureau is continually called upon for advice in the solution of problems confronting those who are either engaging in fish culture as a private venture or who are interested in developing the possibilities of certain public waters. A station such as that at Fairport, where the hatching and rearing of fishes to a size suitable for the table can go hand in hand with systematic scientific observation and experiment, renders a long needed and invaluable service in providing an experience supplemental to that gained in practical fish-cultural work.

During the year the Bureau conducted a survey of the Bonneville System of Utah with reference primarily to its fishery resources and incidentally to the problems of fish protection in irrigation ditches. This system comprises Utah Lake and Provo, Beaver, Bear, Logan, and other rivers. Interesting and unexpected discoveries were made of several new species of whitefish that appear to be indigenous to the system, and all of which are good food fish. Utah Lake is famous for its suckers and carp, tons of which are sometimes shipped to eastern markets, some going even to New York. Generally speaking, however, the fish of the Bonneville System are not plentiful enough to be of great commercial value except locally. With the development of power plants and the growth of agriculture, they are certain to become less numerous, unless due care is taken to conserve the fish supply as far as may be done consistently with the pursuit of other objects of greater economic importance.

SERVICE OF THE BIOLOGICAL LABORATORIES.

The seaside laboratories, which opened for the summer season just before the close of the last fiscal year, were in active operation until about the middle of September, 1915. Various investigations were pursued chiefly through the employment of the temporary services of specialists in several lines.

The Woods Hole, Mass., laboratory is intended to serve as a nucleus for investigations of more direct reference to the New England and Middle Atlantic fisheries as well as for more technical investigations of general application. In some respects this establishment is better adapted for technical studies than any other laboratory of the Bureau, and it is hoped to improve the facilities for biophysical and biochemical studies that form essential phases of certain fishery investigations. The lack of a permanent scientific staff for this station causes its scientific operations to be confined largely to the summer season, when temporary professional services are most readily available. The principal topics of investigation during the past season may be cited. There have been studies of oysters, elsewhere referred to, which related chiefly to nutrition, greening, and propagation. The studies of nutrition had especial reference to the discovery of methods of fattening that might not be open to the objections properly raised against some of the common practices. The investigation of greening, directed at a condition which has served as a serious blight on oyster culture in certain localities, and of "green gill," an entirely distinct phenomenon, was also associated with this laboratory. Studies of the larval development of fishes have been followed with results narrated elsewhere.

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Other subjects of investigation were the parasites of fishes and the effect of such parasites upon the vitality of the individuals; the effect upon fishes of certain mineral salts which may be present either as a normal constituent of some spring waters or as a consequence of pollution; the metabolism of fishes and oxygen utilization, subjects which have a bearing upon the propagation and rearing of fishes; the bacteriology of fishes; the biology and the utilization of sea mussels; and the possibilities of utilization of other waste fishes. As usual the facilities of the laboratory were extended to a few independent investigators whose studies were pursued without expense to the Bureau.

The Beaufort, N. C., laboratory is a center for investigations that look to the better development of the fisheries of the South Atlantic coast. Allusion has been made to the study of the mullet and to the survey of fishing grounds which has revealed opportunities for offshore winter operation and contributed to the development of a fishery that is as yet unduly limited. The successful experiments in terrapin culture are also more fully described elsewhere. Special attention is being devoted to the breeding habits of fishes, the larval development of fishes, and, as opportunity offers, to the possibilities of propagation of certain sea fishes which support important fisheries in the South Atlantic States. Interesting observations were made and a report was prepared dealing with the habits of certain species of small fish that are denizens of brackish and fresh waters and that are serviceable in the extermination of mosquito larvæ and hence in the maintenance of public health.

Efficient study of the food of fishes and of the movements of fishes, as directed by the search for food, or the avoidance of enemies, demands an exact knowledge of the forms of animal and plant life which may be encountered in the local waters or which may be found in the stomachs of the fishes. Careful systematic studies of certain groups of animal and plant life have therefore been in progress for some time. During the past fiscal year there was completed for publication a valuable report on the sharks and rays of the Beaufort region; and another comprehensive report dealing with the decapod crustacea, a group that includes the crabs and other forms of most direct economic usefulness, has also been completed and submitted for publication. Systematic studies of certain groups of fish parasites have been completed. A report of the algæ of the region is nearing completion, while the diatoms and protozoa, among the lowest forms of minute plant and animal life, as well as the higher fishes, are now subjects of investigation.

In the assurance that the development of commercial fisheries will soon demand more strongly the conservation of important shellfish, serious attention is being given to the life history of the quahaug or hard clam and the principal crustacean forms.

The Beaufort laboratory has also been found a favorable place for the prosecution of certain special problems that have not a particular regional significance. At this place there are pursued investigations of the toxicity of certain chemicals to marine borers and of the protection of wood against these disastrous pests, in which studies the Bureau has enjoyed the cooperation of the forest products laboratory of the Forest Service and the sympathetic interest of railway companies and other commercial bodies.

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The enlargement of the island upon which the laboratory is located, in consequence of the deposition of material dredged by the War Department from nearby channels; the recent additions to the building authorized by Congress; and the grading and sodding of large portions of the island have added greatly to the appearance and to the stability of the property. The station would be of much greater practical service to the fishing industries of the coast were it enabled, through the provision of an adequate permanent staff, to carry on more extensive permanent experimental work. Investigations temporarily pursued serve a useful purpose in laying the basis for practical work, but it is usually only through continuous experimentation that the inevitable difficulties of new practical work are discovered and successfully overcome, as must finally be done to pave the way to substantial benefits. The terrapin experiments offer a concrete example of a businesslike mode of procedure in fishery experiment work, while other opportunities are awaiting with perhaps greater possibilities.

The Key West, Fla., laboratory becomes nearer to realization with the developments of the past fiscal year, during which the Government has assumed title to the site and Congress has provided the necessary additional appropriation for its construction. The preliminary sketch plans were completed and at the close of the year the final plans were in course of preparation. Bids are expected to be sought by advertisement at no distant date. The laboratory site is properly chosen near a base of supplies accessible by water and rail and the seat of important commercial fisheries. Situated as it is, entirely remote from the influence of fresh-water rivers and on the thoroughfare from gulf to ocean, the conditions should be eminently suitable for work with marine forms. It is hoped to employ the most substantial method of construction, not only because the peculiar conditions of the geographic location demand it but because it is regarded as sound business policy to provide against the continued necessity for repairs and unnecessary operating costs.

When this laboratory is in operation and provided with a staff of trained investigators, the service rendered by the Bureau to the fisheries of the Gulf and extreme South Atlantic coasts will be of more palpable benefit. Some of the evident opportunities are to be found in the study of the artificial propagation of the green turtle, the investigation of such useful forms as the spiny lobster and the stone crab, the fostering of the struggling industry of sponge culture, and the study of the important food fishes of the Gulf of Mexico and Straits of Florida.

The Fairport, Iowa, station, having a permanent scientific staff, is in active operation during the entire year. During the summer season its staff is temporarily augmented in order that particular problems arising from the regular investigations at this station or related to the other activities of the Bureau may be attacked by specialists in particular lines of study. As at the marine laboratories, the facilities of the station are extended to approved independent investigators, who, as table occupants, pursue their researches without cost to the Government.

The propagation of mussels, the fish-cultural experiment work, the investigations of the food of fishes, and certain studies of conditions in the Mississippi River, as elsewhere referred to, are among the

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subjects under consideration at Fairport during the year. One of the investigations pursued at this laboratory was of particular interest in establishing the fact that mussels may absorb nutritive substances in solution in the water not only through the alimentary tract but directly through the surface cells. Other studies in progress relate to the propagation of species of mussels not yet susceptible to practical cultural methods, the relations of fishes and mussels in nature, the possibilities of rearing mussels without parasitism, the food of mussels, the copepod parasites of fishes, and the constitution of the blood of fishes.

The equipment of the station in ponds and other facilities for the efficient prosecution of its work has been materially increased during the year. A bulletin descriptive of the equipment and functions of the Fairport station has just been published.

MISCELLANEOUS INVESTIGATIONS.

The Bureau has taken advantage of an opportunity to utilize the services of a specialist traveling abroad to secure information regarding recent significant developments in foreign pearl fisheries and expects to have a report available within the next year.

The imperative necessity for seeking new sources of potash for use in agricultural and commercial enterprises has led to the sudden development of an industry of kelp harvesting, especially in the region of San Diego, Cal. Simultaneously there arose questions as to the possible effect of the cutting of kelp upon the fisheries. Just before the close of the fiscal year it had been arranged to begin a study of the kelp fields and the method of harvesting with the view of securing definite information as to the relations of fish and shellfish to the kelp groves as they might be affected by the operations of harvesting.

For two or three years the Bureau has been searching for suitable supplies of hydroids, or the "sea moss" of commerce, which had previously been imported from Europe in considerable quantities. The dyed product is used for decorative and millinery purposes, and the importations for the only year for which statistics are available (1909) amounted to more than 300,000 pounds, valued at $47,558. In connection with the survey of the Chesapeake Bay, considerable quantities were located at depths of 18 to 30 fathoms, and experiments were made to devise efficient methods of collecting. An experienced manufacturer accompanied the investigator on one of the cruises and pronounced the material of excellent quality. Further observations must be made to determine the seasons when the moss may be found in greatest abundance and highest quality.

One of the most serious handicaps upon the halibut fishery of the northwest coast is the occurrence of "mushy" halibut, which is especially characteristic of certain grounds and which begins to be noted in early summer, increasing in prevalence until the unmarketable fish form so large a proportion of the catch as to compel the abandonment of the fishery or the removal to other and less accessible grounds for the remainder of the season. Through the study of material supplied to a specialist in the employ of the Bureau, it has been ascertained that the "mushy" condition is caused by a minute protozoan parasite which multiplies abundantly and brings about

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a degeneration of the muscle tissue. As soon as it is possible to do so, the Bureau will undertake a more extensive investigation in the field in order to learn the distribution of the parasite, the conditions that bring about its occasional increase in abundance, and any possible method of remedy or control.

The cooperative work with the State Geological and Natural History Survey of Wisconsin in an inquiry into the biological and physical conditions of life in inclosed waters has been continued. Progress has been made upon the reports of investigations of Lake Champlain and those of the lakes of Washington and Idaho.

In response to a widespread interest in the subject of frog culture, evidenced by the daily receipt of inquiries for information and advice in the matter, there is in preparation a report dealing with the natural history of frogs. Field studies are also being conducted.

An interesting test was made in connection with an experiment in rearing fresh-water mussels at the Fairport station. While the commercial mussels are native to rivers and not to still waters, some fishes which had been infected with the glochidia of mussels in the way ordinarily followed in practical operations were subsequently retained in floating crates and others were placed in station ponds. After two seasons of growth it was found possible to cut and finish buttons from the shells of these artificially propagated mussels. The rate of growth was much more rapid than had been expected. It is not assumed that mussels can be reared commercially in such waters, but the experiment is of interest and value as throwing light upon the nature of the results to be expected from the practical operation in public waters.

While the Federal Government exercises no jurisdiction over the pollutions of waters as affecting fisheries, the Bureau can render a very practical service in the investigation of reported cases of pollution where the importance of the stream and the alleged extent of the damage done is such as to warrant its taking cognizance of the matter. In some instances the reports are found to be without due foundation, while the agencies complained of are exercising all proper care. A report of the actual facts based upon a careful and unprejudiced examination of conditions serves to allay suspicions and prevent the further existence of dissatisfaction. In other cases the conditions are observed to be as alleged, but abatement is effected through a clear and convincing presentation of the facts to the offending parties, coupled with suggestions as to practical remedies and an appeal for cooperation. Again, there may be encountered those who are carelessly permitting industrial wastes to render a stream uninhabitable for the more desirable fishes and who are not amenable to reasonable suggestions. In such cases the findings of the Bureau can still serve a useful purpose in directing public attention to a wanton abuse and in reinforcing those who may be interested to seek relief by process of law. The Bureau has within the year conducted a number of investigations of this kind and the reports have been placed as promptly as possible in the hands of the parties interested.

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COMMERCIAL FISHERIES.

Investigations completed by the Bureau during the year, in addition to the work of local agents in collecting data for important mussel fisheries on the Atlantic and Pacific coasts, included canvasses of the fresh-water mussel fishery of the Mississippi River and its western tributaries from Kansas northward; the fisheries of Lakes Pepin and Cooper in the Mississippi River, the former between Minnesota and Wisconsin, and the latter at Keokuk, Iowa; the crab industry of Maryland and Virginia; the shad and alewife industry of Chesapeake Bay and tributaries; the coastal fisheries of New York and New Jersey, exclusive of shellfish, for 1915; and the shad fishery of the Hudson River for 1915 and 1916. The inquiries relating to the fresh-water mussel fishery in the region referred to, and those relating to the shad and alewife industry, were begun the latter part of the preceding fiscal year.

FRESH-WATER MUSSEL FISHERY.

The general canvass of the fresh-water mussel fishery, which has been in progress for several years, was completed during the past year. The streams covered were the Mississippi River and its western tributaries from Kansas northward, except the Neosho River in Kansas, which was included in the work of a previous year; and the data collected were for the calendar year 1914. A special bulletin giving the results of the canvass was issued and distributed. The number of persons engaged in the mussel fishery in these streams in 1914 was 1,873, and the investment in boats, fishing apparatus, and shore and accessory property amounted to $132,267. The products included 8,539 tons of shells, valued at $148,960, and pearls found in the mussels to the value of $62,902, a total of $211,862. All the shells were used in the manufacture of pearl buttons. The principal fishing apparatus used in taking mussels is the crowfoot bar, the catch with this appliance in this region amounting to 6,524 tons of shells, valued at $120,859. The remainder of the catch was taken with forks, rakes, diggers, tongs, scoops, or basket rakes, and by hand while wading.

Mississippi River.—The most important of these streams is the Mississippi River, the products of which amounted to 6,626 tons of shells, valued at $125,948, and $50,562 worth of pearls, a total of $176,510 in value. This shows a decline of about 58 per cent in quantity and 61 per cent in value of the output of shells and pearls since 1903, the last previous year for which data are available. In view of the fact that the mussel fishery has been prosecuted in the Mississippi River for nearly 25 years, the decline in the output is not so surprising. Nearly 94 per cent of the river's catch in 1914 was taken with crowfoot bars, and of the remainder 2 per cent were taken with forks, 2 per cent with rakes, and 2 per cent with diggers and tongs. Fishing with crowfoot bars is more vigorously prosecuted in Lake Pepin than in any other portion of the river. In many cases two rowboats or scows are connected by a bar or pole 10 to 15 feet long, a gasoline boat pushing against the middle of the bar being used as the propelling power. The two small boats are provided with 4 crowfoot bars, 3 of which are being fished while the

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fourth is having the mussels removed from it. Usually two men, but occasionally only one man, handle such an outfit.

Mussel fishing on this river in 1914 was followed from Pine Bend, about 20 miles below St. Paul, Minn., to the mouth of the Missouri River, near Alton, Ill., the fishing ending abruptly at that point. A few shells have been taken as far up the river as Bemidji, Minn., but no sale of them has ever been made. Probably the most productive portion of the river in 1914 was in the vicinity of Frontenac, Minn., where, within a few miles, the 45 men engaged caught 645 tons of shells, valued at $10,570, and $2,100 worth of pearls and slugs. The beds near Maiden Rock, Wis., were also quite profitable, the output of 36 men amounting to 390 tons, valued at $6,630, and $2,100 worth of pearls. Lake Pepin as a whole produced 1,932 tons of shells, valued at $31,486, and $11,820 worth of pearls. It is said that there were at least 1,000 men fishing for mussels in Lake Pepin in 1911, the catch amounting to about 4,000 tons, compared with an output of less than 2,000 tons in 1914 taken by 281 fishermen.

In 1900, when the first mussel fishing was done at Red Wing, Minn., there were said to have been 75 boats at work on the beds there, compared with 8 boats in 1914. The first mussel fishing at New Albin, Iowa, was in 1899, when there were at least 20 men working on the beds, which yielded an average day's catch per man of several thousand pounds, compared with 150 to 200 pounds now. In the early days of the fishery very few shells other than niggerheads were saved. As recently as 1910 as many as 70 or 80 men worked on the mussel beds opposite New Boston, Ill., while in 1914 only 15 men were engaged and small catches were made. There were 15 or 18 mussel fishermen out of Quincy, Ill., in 1900, while in 1915 there were none, this being due both to overfishing and to the building of dams and dikes by the Government to preserve the channel of the river. Similar changes have taken place at Canton, Mo., where a button factory is located, but the shell supply is obtained from various parts of the Mississippi Valley. The mussel beds in the vicinity of Prairie du Chien a few years ago were the most prolific by far of any in the entire river, but in 1914 the catch of 100 men in that vicinity amounted to only 385 tons, valued at $6,872, and $5,500 worth of pearls and slugs.

A great decline has taken place also in the beds near Muscatine, Iowa, where the industry was first established in 1891. The near exhaustion of the beds in this vicinity has caused many of the local fishermen to seek unworked mussel streams in various parts of the country.

The catch of the Mississippi River as a whole was divided among the different species approximately as follows: Niggerheads, 25 per cent; three-ridges (including blue-points), 23 per cent; wartybacks, 13 per cent; muckets, 13 per cent; pig-toes, 6 per cent; washboards, 6 per cent; pocketbooks, 3 per cent; yellow sand-shells, 2 per cent; Missouri niggerheads, 2 per cent; pistol-grips, 2 per cent; and monkey-faces, 1 per cent. The remaining 4 per cent consist of black sand-shells, ladyfingers, bullheads, and a few other unimportant species.

Cedar River.—The catch of this river was apportioned among the different forms of apparatus as follows: 54 per cent with forks, 22 per cent with hands while wading, 18 per cent with crowfoot bars, and the remainder with rakes. Muckets predominated in the catch,

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with a percentage of 57. The remainder was divided as follows: Three-ridges and blue-points, 18 per cent; pocketbooks, 10 per cent; warty-backs, 3 per cent; pigtoes, 1 per cent; and a few each of pistol-grips, black sandshells, butterflies, maple-leaves, and other unimportant species.

A few pearls and slugs were taken from this river as far up as Osage, Iowa, in 1914, but Charles City, Iowa, and vicinity was the upper limit of shell fishing. The most productive beds were in the vicinity of Cedar Rapids. This was also the lowest point on the river where shells were taken. The catch of 15 men in that locality amounted to 130 tons, valued at $2,020, and $975 worth of pearls and slugs.

The first mussel shells were taken for market from this river in 1905 near Vinton, where a button factory was established about that time and operated for several years.

Des Moines River.—More than 75 per cent of the river's output is taken between Ottumwa, Iowa, and about 15 miles below that city. Forty-five tons of shells were taken from the east fork of the river as far north as between Bert and Bancroft, this being the first year in which work was done on that branch of the river. The lowest point at which shells were taken was near Keosauqua, Iowa, an output of 17 tons being shown for that vicinity. The prevailing species were three-ridges (including blue-points), warty-backs, muckets, and pigtoes, with percentages of 45, 18, 15, and 13, respectively. The remainder was made up of pistol-grips, maple-leaves, monkey-faces, lady-fingers, pocketbooks, etc. About 63 per cent of the catch was made with forks, 29 per cent with hands while wading, and the remainder with rakes. The first record of any shells being taken from this river was near Keosauqua in 1910.

James River.—This river, said to be the longest unnavigable river in the United States, supported mussel fisheries from Riverside, S. Dak., to within a few miles of its mouth—Yankton, S. Dak. The most prolific beds were between Milltown and Olivet, S. Dak., and those located a few miles above and below Yankton. The total output of the river in 1914 amounted to 260 tons, valued at $3,498, and $700 worth of pearls and slugs. Twenty-seven persons were engaged in the fishery and had an investment of $1,460, including apparatus, boats, and shore property. About 90 per cent of the catch was taken with scoops, or basket rakes, and the remainder with forks and by hand. The output was composed of 85 per cent three-ridges (including blue-points), 10 per cent fat muckets, and the remainder maple-leaves, pocketbooks, and heel-splitters. The first record of any mussel fishing being done in the James River was in 1912. Pearls, however, were taken several years previously.

Osage and Marais des Cygnes Rivers.—The Osage and Marais des Cygnes Rivers are treated as one, the latter being the name given to that portion of the river flowing through Kansas. Forty men, with an investment of $1,261, were engaged in shelling on this river from near Trading Post, Kans., as far down as Warsaw, Mo. The total output in 1914 amounted to 204 tons of shells, with a value of $2,111, and $380 worth of pearls. About 37 per cent of the catch was made with forks, 26 per cent with hands while wading, 22 per cent with crowfoot bars, and the remainder with diggers and tongs. The output was apportioned among the different species as follows: Three-

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ridges (including blue-points), 43 per cent; washboards, 17 per cent; pig-toes, 15 per cent; muckets, 12 per cent; and a few each of warty-backs, monkey-faces, lady-fingers, pistol-grips, maple-leaves, and butterflies. The most prolific beds were those between Warsaw and 55 miles above that town, 22 men working on these beds obtaining 110 tons, with a value of $1,540, and $100 worth of pearls.

Wapsipinicon River.—Mussel fishing on this river in 1914 extended from Independence as far down as Anamosa, Iowa. The total output was 132 tons, valued at $1,797, together with $765 worth of pearls and slugs. The 37 persons engaged had an investment, in apparatus, boats, and shore property, of $811. More than 50 per cent of the catch was made with forks, the remainder being taken by hand while wading, and with crowfoot bars, and rakes. The catch was divided among the different species as follows: 71 per cent muckets, 15 per cent blue-points and three-ridges, 10 per cent pocketbooks, and the remainder warty-backs, squaw-foots, pig-toes, and heel-splitters. The first mussel fishing on this river of which there is any record was in 1908.

Iowa River.—The total output of this river in 1914 was 93 tons of shells, valued at $1,038, and $2,975 worth of pearls and slugs. The 86 persons engaged had an investment of $345 in apparatus, $500 in boats, and $300 in shore property. More than one-half of the shells were taken with hands while wading, about 25 per cent with forks, and the remainder with crowfoot bars and rakes. The shells were apportioned among the various species as follows: 42 per cent muckets, 30 per cent pocketbooks, 20 per cent three-ridges (including blue-points), and the remainder divided among warty-backs, squaw-foots, pistol-grips, black sand-shells, maple-leaves, pig-toes, lady-fingers, heel-splitters, and butterflies. Pearls were found as far up the river as Popejoy, but the upper limit of mussel fishing was near Eldora, from which place it was followed at intervals as far down the river as North Liberty. The first mussels for commercial use were taken from this river in 1908.

Minnesota River.—Mussels were taken at intervals along this river in 1914 from Montevideo, Minn., to within a short distance of its mouth, the total output amounting to 118 tons of shells, valued at $1,254, and $455 worth of pearls. The 13 men engaged had $120 invested in apparatus, $280 in boats, and $145 in shore property. The most important catch was made in the vicinity of New Ulm, Minn. The entire output of the river was taken with crowfoot bars, and was composed of 56 per cent three-ridges (including blue-points), 27 per cent muckets, 6 per cent washboards, 5 per cent warty-backs, and a few each of niggerheads, pig-toes, and pistol-grips. The first commercial fishing in the Minnesota River was done near its mouth in 1905 by a few fishermen from the Mississippi River, who remained only a short time. Work was followed up more steadily from 1909.

Meramec River.—Mussel shells were taken from the Meramec River in 1914 at various localities between St. Clair and Valley Park, Mo., the total output amounting to 90 tons, valued at $830, and $465 worth of pearls and slugs. The 30 fishermen engaged had an investment of $280 in apparatus, boats, and shore property. Nearly nine-tenths of the mussels were taken by hand and the remainder with crowfoot bars. Muckets composed about 43 per cent, three-ridges

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26 per cent, washboards 8 per cent, and warty-backs and pistol-grips, or buckhorns, 7 per cent each of the catch, the balance being made up of pig-toes, niggerheads, maple-leaves, and monkey-faces. The first commercial fishing on this river was in 1910.

Blue River.—Some mussel fishing was done on this river near Beatrice, Nebr., in 1914, a total catch of 55 tons of shells, valued at $770, being reported.

South Skunk River.—The 5 fishermen on this river caught 43 tons of mussel shells, valued at $602, and $310 worth of pearls and slugs from the South Skunk River near Oskaloosa, Iowa, in 1914. Some shells were taken from the Skunk River proper in 1913, but none in 1914.

Shell Rock River.—Mussels were taken from this river between Marble Rock and Shell Rock, Iowa, the total output, however, being only 32 tons, valued at $354, and $210 worth of pearls and slugs. Only 6 men were engaged on the entire stream in 1914. One-half of the catch was made with forks, and the remainder with hands, crowfoot bars, and rakes. The different species were found in the following proportions: Pocketbooks, 47 per cent; muckets, 43 per cent; blue-points, or three-ridges, 8 per cent; and a few squaw-foots. No shelling was done on the river previous to 1908.

Cottonwood and Bourbeuse Rivers.—The two remaining streams in the region canvassed were the Cottonwood and Bourbeuse Rivers. Shells were taken on the former river at Cottonwood Falls, Kans., and on the latter near St. Clair, Mo., the combined catch of the two rivers amounting to 65 tons, valued at $430, and $60 worth of pearls and slugs.

Statistics of the mussel fishery.—Complete statistics for all of the mussel-bearing streams of the Mississippi Valley show a total of 10,331 persons engaged in the fishery, an investment of $540,608, and a catch of 51,571 tons of shells, valued at $825,776, together with $376,284 worth of pearls and slugs; the total value of the products amounting to $1,202,060. Statistics of the mussel fishery of the Mississippi River and its western tributaries from Kansas northward for 1914, and of the entire Mississippi Valley in three sections for 1912, 1913, and 1914, respectively, are given in the following tables:

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FRESH-WATER MUSSEL FISHERY OF THE MISSISSIPPI RIVER AND ITS WESTERN TRIBUTARIES FROM KANSAS NORTHWARD IN 1914.[a]

Items.	Blue River, Nebr., and Cottonwood River, Kans.		Cedar River, Iowa.		Des Moines River, Iowa.		Iowa River, Iowa.		James River, S. Dak.		Meramec and Bourbeuse Rivers, Mo.	
Persons engaged:	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Fishermen	7	.....	80	.....	31	.....	86	.....	27	.....	32	.....
Shoresmen	.....	.....	10	.....	....	.....	....	.....	....	.....	....	.....
Total	7	.....	90	.....	31	.....	86	.....	27	.....	32	.....
Fishermen, classified by methods used:												
Crowfoot bars	.....	.....	25	.....	....	.....	20	.....	....	.....	4	.....
Forks	.....	.....	77	.....	31	.....	85	.....	2	.....	....	.....
Rakes	.....	.....	6	.....	3	.....	40	.....	....	.....	....	.....
Diggers or dredgers	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....
Tongs	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....
Scoops, or basket rakes	.....	.....	....	.....	....	.....	....	.....	25	.....	....	.....
Waders	7	.....	60	.....	30	.....	86	.....	2	.....	32	.....
Total, exclusive of duplication	7	.....	80	.....	31	.....	86	.....	27	.....	32	.....
Boats:												
Rowboats	7	$55	74	$660	31	$295	82	$500	13	$245	28	$130
Gasoline boats	.....	.....	3	265	....	.....	....	.....	9	995	....	.....
House-boats	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....
Total	7	55	77	925	31	295	82	500	22	1,240	28	130
Apparatus:												
Crowfoot bars, pairs	.....	.....	25	365	....	.....	20	200	....	.....	2	20
Forks	.....	.....	77	103	31	44	85	115	2	3	....	.....
Rakes	.....	.....	6	6	3	2	40	30	....	.....	....	.....
Diggers or dredgers	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....
Tongs	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....
Scoops, or basket rakes	.....	.....	....	.....	....	.....	....	.....	15	67	....	.....
Total	.....	.....	....	474	....	46	....	345	....	70	....	20
Shore and accessory property	.....	10	....	565	....	375	....	300	....	220	....	150
Total investment	.....	65	....	1,964	....	716	....	1,145	....	1,530	....	300
Products:												
Shells—												
With crowfoot bars, tons	.....	.....	87	994	....	.....	10	110	....	.....	10	90
With forks, do	.....	.....	261	3,316	211	2,777	23	256	20	240	....	.....
With rakes, do	.....	.....	20	285	25	325	10	110	....	.....	....	.....
With diggers or dredgers, tons	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....
With tongs, tons	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....
With scoops, or basket rakes, tons	.....	.....	....	.....	....	.....	....	.....	232	3,162	....	.....
With hands, do	110	1,120	117	1,331	100	1,300	50	562	8	96	90	820
Total	110	1,120	485	5,926	336	4,402	93	1,038	260	3,498	100	910
Pearls	.....	100	....	3,665	....	2,305	....	2,975	....	700	....	475
Total value of products	.....	1,220	....	9,591	....	6,707	....	4,013	....	4,198	....	1,385

[a] Not including the Neosho River, shown in another table.

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FRESH-WATER MUSSEL FISHERY OF THE MISSISSIPPI RIVER AND ITS WESTERN TRIBUTARIES FROM KANSAS NORTHWARD IN 1914[a]—Continued.

Items.	Minnesota River, Minn.		Mississippi River.		Osage and Marais des Cygnes Rivers, Mo. and Kans.		Shell Rock and South Skunk Rivers, Iowa.		Wapsipinicon River, Iowa.		Total.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Persons engaged:												
Fishermen	13	.....	1,383	.....	39	.....	11	.....	35	.....	1,744	.....
Shoresmen	....	.....	115	.....	1	.....	1	.....	2	.....	129	.....
Total	13	.....	1,498	.....	40	.....	12	.....	37	.....	1,873	.....
Fishermen, classified by methods used:												
Crowfoot bars	13	.....	1,364	.....	8	.....	3	.....	15	.....	1,452	.....
Forks	....	.....	48	.....	25	.....	10	.....	35	.....	313	.....
Rakes	....	.....	33	.....	....	.....	5	.....	2	.....	89	.....
Diggers or dredgers	....	.....	9	.....	2	.....	....	.....	....	.....	11	.....
Tongs	....	.....	14	.....	10	.....	....	.....	....	.....	24	.....
Scoops, or basket rakes	....	.....	.....	.....	....	.....	....	.....	....	.....	25	.....
Waders	....	.....	.....	.....	17	.....	5	.....	29	.....	268	.....
Total, exclusive of duplication	13	.....	1,383	.....	39	.....	11	.....	35	.....	1,744	.....
Boats:												
Rowboats	9	$95	734	$12,360	32	$205	10	$80	35	$235	1,055	$14,860
Gasoline boats	3	185	731	72,755	2	650	....	.....	1	100	749	74,950
House-boats	....	.....	55	6,595	....	.....	....	.....	....	.....	55	6,595
Total	12	280	1,520	91,710	34	855	10	80	36	335	1,859	96,405
Apparatus:												
Crowfoot bars....pairs	10	120	1,405	16,816	8	80	3	39	15	200	1,488	17,840
Forks	....	.....	48	103	25	31	10	13	35	44	313	456
Rakes	....	.....	23	51	....	.....	5	4	2	2	79	95
Diggers or dredgers	....	.....	32	164	2	10	....	.....	....	.....	34	174
Tongs	....	.....	14	70	....	.....	....	.....	....	.....	14	70
Scoops, or basket rakes	....	.....	.....	.....	....	.....	....	.....	....	.....	15	67
Total	....	120	.....	17,204	....	121	....	56	....	246	.....	18,702
Shore and accessory property	....	145	.....	14,795	....	285	....	85	....	230	.....	17,160
Total investment	....	545	.....	123,709	....	1,261	....	221	....	811	.....	132,267
Products:												
Shells—												
With crowfoot bars, tons	118	1,254	6,216	117,238	45	630	13	168	25	375	6,524	120,859
With forks.....tons	....	.....	149	3,308	75	730	41	526	72	985	852	12,138
With rakes.....do	....	.....	132	3,049	....	.....	11	150	8	100	206	4,019
With diggers or dredgers.....tons	....	.....	85	1,393	20	280	....	.....	....	.....	105	1,673
With tongs.....do	....	.....	44	960	10	140	....	.....	....	.....	54	1,100
With scoops, or basket rakes.....tons	....	.....	.....	.....	....	.....	....	.....	....	.....	232	3,162
With hands.....do	....	.....	.....	.....	54	331	10	112	27	337	566	6,009
Total	118	1,254	6,626	125,948	204	2,111	75	956	132	1,797	8,539	148,960
Pearls	....	455	.....	50,562	....	380	....	520	....	765	.....	2,902
Total value of products	....	1,709	.....	176,510	....	2,491	....	1,476	....	2,562	.....	211,862

[a] Not including the Neosho River, shown in another table.

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Fresh-water Mussel Fishery of the Mississippi Valley.

Items.	Streams tributary to Gulf of Mexico from Ohio River southward in 1912.[a]		Streams tributary to Great Lakes and Ohio and Mississippi Rivers north of the Ohio and east of the Mississippi River in 1913.[b]		Mississippi River and its western tributaries from Kansas northward in 1914.[c]		Total.[d]	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Persons engaged:								
Fishermen	4,665		3,337		1,744		9,746	
Transporters	91						91	
Shoresmen	110		255		129		494	
Total	[e]4,866		[f]3,592		[g]1,873		10,331	
Fishermen, classified by methods used:								
Crowfoot bars	2,793		2,216		1,452		6,461	
Forks	364		1,116		313		1,793	
Tongs	1,232		513		24		1,769	
Diggers			140		11		151	
Dredgers	43		63				106	
Rakes	21		93		89		203	
Scoops, or basket rakes					25		25	
Miscellaneous apparatus			13				13	
Waders	1,051		944		268		2,263	
Total, exclusive of duplication	4,665		3,337		1,744		9,746	
Boats and vessels:								
Rowboats and barges	4,276	$26,631	2,199	$16,712	1,055	$14,860	7,530	$58,203
Gasoline boats	446	59,545	1,031	87,320	749	74,950	2,226	221,815
House-boats	579	46,990	115	14,610	55	6,595	749	68,195
Vessels transporting	25	56,265					25	56,265
Total	5,326	189,431	3,345	118,642	1,859	96,405	10,530	404,478
Apparatus:								
Crowfoot bars, pairs	2,795	31,896	2,212	24,395	1,488	17,840	6,495	74,131
Forks	364	427	1,103	1,441	313	456	1,780	2,324
Tongs	1,245	7,321	513	2,796	14	70	1,772	10,187
Diggers			102	658	34	174	136	832
Dredges	19	1,500	36	63			55	1,563
Rakes	21	58	85	119	79	95	185	272
Scoops, or basket rakes					15	67	15	67
Miscellaneous apparatus				9				9
Total		41,202		29,481		18,702		89,385
Shore and accessory property		10,853		18,732		17,160		46,745
Total investment		241,486		166,855		132,267		540,608
Products:								
Shells—								
With crowfoot bars, tons	14,531	210,521	15,258	245,477	6,524	120,859	36,313	576,857
With forks, do	1,277	15,283	3,292	55,757	852	12,138	5,421	83,178
With tongs, do	3,201	55,568	790	13,559	54	1,100	4,045	70,227
With diggers, do			1,733	28,200	105	1,673	1,838	29,873
With dredges, do	303	5,091	225	4,500			528	9,591
With rakes, do	24	379	161	2,856	206	4,019	391	7,254
With scoops, or basket rakes, tons					232	3,162	232	3,162
With miscellaneous apparatus, tons			34	453			34	453
With hands, do	379	7,764	1,824	31,408	566	6,009	2,769	45,181
Total	19,715	294,606	23,317	382,210	8,539	148,960	51,571	825,776
Pearls		149,121		164,261		62,902		376,284
Total value of products		443,727		546,471		211,862		1,202,060

[a] From Statistical Bulletin 305. This includes Neosho River, Kans.
[b] From Statistical Bulletin 314. This does not include tributaries of the Ohio River in Ohio, data for which were shown in Statistical Bulletin 305.
[c] From Statistical Bulletin 343. This does not include the Neosho River, Kans., data for which were shown in Statistical Bulletin 305.
[d] Obtained by combining statistics for the three sections of the Mississippi Valley for 1912, 1913, and 1914, respectively.
[e] Includes 56 women.
[f] Includes 253 women.
[g] Includes 118 women.

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FISHERIES OF LAKE PEPIN AND LAKE COOPER.

Lake Pepin.—Lake Pepin, an expansion of the Mississippi River between Minnesota and Wisconsin, is nearly 25 miles long and 3 miles wide at its greatest breadth. It supports quite extensive fisheries. Pepin, Wis., is the most important town in the extent of its fisheries along the lake. Maiden Rock, Wis., also supports important fisheries.

In 1914 there were 137 fishermen engaged in the industry, their total investment amounting to $43,599. The investment included 28 gasoline boats, worth $7,625; 53 rowboats, valued at $1,300; 1 houseboat, valued at $100; 295 fyke nets, valued at $24,995; 14 seines, valued at $3,340; 664 anchored gill nets, valued at $4,421; 8 trap nets, with a value of $480; $3 worth of lines, and $1,335 worth of shore and accessory property. The total output of the lake amounted to 758,670 pounds of fish, with a value to the fishermen of $33,719. Buffalofish, German carp, fresh-water drum, and catfish made up 94 per cent of the value of the entire catch. The most important apparatus used was the fyke net, known locally as hoop net. The catch therewith amounted to 337,446 pounds of fish, valued at $18,973. The leading species included in the catch were buffalofish, fresh-water drum, German carp, suckers, and quillbacks, or white carp. Seines ranked next in importance with a catch of 291,216 pounds of fish, having a value of $8,219. German carp and buffalofish were the two leading species taken, the value of the two being more than three-fourths that of the entire seine catch. The catch by anchored gill nets amounted to 126,198 pounds, valued at $6,432. As in the case of seines, the principal species taken were the buffalofish and German carp. Trap nets and lines were also used, but the combined catch of the two amounted to only 3,810 pounds, with a value of $95.

The fishery conditions on Lake Pepin have improved very much within the past 15 years by the opening up of the New York market during the winter season. Previously there was only a local demand for the fish. A considerable portion of the winter fishing is done through the ice. Comparatively few fish are handled during warm weather, as the demand is then very light. There is a close season along the lake in both Minnesota and Wisconsin from April 15 to June 15.

Lake Cooper.—Lake Cooper, which is merely a widening of the Mississippi River formed by back water from the dam at Keokuk, Iowa, has a length of about 50 miles.

There was a total of 105 men engaged in the fisheries of this lake during 1914. These men had an investment of $16,190, and caught 661,135 pounds of fish, valued at $23,300. Buffalofish, German carp, and catfish contributed 94 per cent of the value of the total catch. The most important form of apparatus used was the fyke net, known locally as bait net. The catch by this form of net amounted to 488,005 pounds, valued at $16,210. The remainder of the catch was taken with lines and trammel nets. The most important species taken both in fyke nets and trammel nets were German carp and buffalofish. Catfish and German carp constituted the principal species taken on lines.

The form of fyke net in general use on Lake Cooper is much smaller than those used on Lake Pepin, having neither leader, wings, nor

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heart, as have most of those on the latter lake. The Lake Cooper fyke nets have from 4 to 7 hoops, 2½ feet in diameter. There was one set in the lake opposite Sandusky, Iowa, in 1914, however, which had 9 hoops, the largest being 11 and the smallest 7 feet in diameter. The total length of this net was 57 feet.

FISHERIES OF LAKE PEPIN AND LAKE COOPER (MISSISSIPPI RIVER) IN 1914.

Items.	Lake Pepin.		Lake Cooper.	
	Number.	*Value.*	*Number.*	*Value.*
Persons engaged:				
Fishermen	135	.....	105	.....
Shoresmen	2	.....	.....	.....
Total	137	.....	105	.....
Boats, apparatus, and other property:				
Gasoline boats	28	$7,625	36	$3,870
Rowboats	53	1,300	81	1,250
House-boats	1	100	10	1,075
Fyke nets	295	24,995	1,378	5,693
Seines	14	3,310	.....	.....
Anchored gill nets	664	4,421	.....	.....
Trammel nets	.....	.....	14	304
Trap nets	8	480	.....	.....
Trot and hand lines	.....	3	.....	153
Shore and accessory property	.....	1,335	.....	3,845
Total	.....	43,599	.....	16,190
Products by apparatus:				
With seines—				
Buffalofish ..... pounds	43,550	2,354	.....	.....
Catfish ..... do	11,785	738	.....	.....
Fresh-water drum ..... do	42,150	400	.....	.....
German carp ..... do	137,920	3,967	.....	.....
Mooneye, fresh ..... do	3,000	25	.....	.....
Mooneye, smoked ..... do	365	16	.....	.....
Quillback, or white carp ..... do	45,775	459	.....	.....
Spoonbill cat, or paddlefish ..... do	2,205	138	.....	.....
Sturgeon, lake ..... do	616	73	.....	.....
Suckers ..... do	3,850	49	.....	.....
Total	291,216	8,219	.....	.....
With fyke nets—				
Buffalofish ..... pounds	173,450	14,068	232,585	8,615
Catfish ..... do	10,975	743	18,415	1,258
Crappie ..... do	.....	.....	50	3
Dogfish ..... do	1,534	16	.....	.....
Fresh-water drum ..... do	85,000	1,964	21,455	642
German carp ..... do	30,547	1,228	209,715	5,456
Mooneye, fresh ..... do	6,300	63	.....	.....
Mooneye, smoked ..... do	1,100	54	.....	.....
Quillback, or white carp ..... do	13,305	378	.....	.....
Spoonbill cat, or paddlefish ..... do	340	19	.....	.....
Sturgeon, lake ..... do	405	50	1,095	69
Suckers ..... do	14,490	390	4,340	164
Sunfish ..... do	.....	.....	50	3
Total	337,446	18,973	488,005	16,210
With anchored gill nets—				
Buffalofish ..... pounds	44,250	3,308	.....	.....
Catfish ..... do	3,760	244	.....	.....
Fresh-water drum ..... do	1,235	21	.....	.....
German carp ..... do	69,050	2,428	.....	.....
Quillback, or white carp ..... do	1,525	27	.....	.....
Spoonbill cat, or paddlefish ..... do	6,332	400	.....	.....
Sturgeon, lake ..... do	46	6	.....	.....
Total	126,198	6,432	.....	.....
With trammel nets—				
Black bass ..... pounds	.....	.....	15	1
Buffalofish ..... do	.....	.....	15,230	543
Catfish ..... do	.....	.....	1,055	69
Crappie ..... do	.....	.....	20	1
Fresh-water drum ..... do	.....	.....	3,065	108
German carp ..... do	.....	.....	61,885	1,408
Sturgeon, lake ..... do	.....	.....	675	40
Total	.....	.....	81,945	2,170

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FISHERIES OF LAKE PEPIN AND LAKE COOPER (MISSISSIPPI RIVER) IN 1914—Con.

Items.		Lake Pepin.		Lake Cooper.	
Products by apparatus—Continued.		*Number.*	*Value.*	*Number.*	*Value.*
With trap nets—					
Catfish	pounds	235	$15	.....	.....
Fresh-water drum	do	3,400	65	.....	.....
Total		3,635	80	.....	.....
With trot and hand lines—					
Buffalofish	pounds	.....	.....	2,085	$94
Catfish	do	75	5	52,065	3,528
Eels	do	.....	.....	3,800	250
Fresh-water drum	do	.....	.....	2,300	77
German carp	do	.....	.....	30,765	959
Pike	do	50	5	.....	.....
Sturgeon, lake	do	.....	.....	130	12
Sunfish	do	50	5	.....	.....
Total		175	15	91,185	4,920
Grand total		758,670	33,719	661,135	23,300
Product by species:					
Black bass	pounds	.....	.....	15	1
Buffalofish	do	261,250	19,728	249,900	9,252
Catfish	do	26,830	1,745	71,535	4,855
Crappie	do	.....	.....	70	4
Dogfish	do	1,534	16	.....	.....
Eels	do	.....	.....	3,800	250
Fresh-water drum	do	131,785	2,450	26,860	827
German carp	do	237,517	7,623	302,365	7,823
Mooneye, fresh	do	9,300	88	.....	.....
Mooneye, smoked	do	1,465	70	.....	.....
Pike	do	50	5	.....	.....
Quillback, or white carp	do	60,605	864	.....	.....
Spoonbill cat, or paddlefish	do	8,877	557	.....	.....
Sturgeon, lake	do	1,067	129	1,900	121
Suckers	do	18,340	439	4,640	164
Sunfish	do	50	5	50	3
Total		758,670	33,719	661,135	23,300

CRAB INDUSTRY OF MARYLAND AND VIRGINIA.

The blue crab is one of the most valuable fishery resources of Chesapeake Bay. In no other body of water is this species so abundant and important. The increasing magnitude of the fishery has occasioned much concern among those solicitous for its future welfare, and there has been much discussion of the necessity for restrictive measures in Maryland and Virginia. The Bureau desired to give the States full and reliable data on which to base any needed action; and accordingly it placed its agents in the field on November 15, 1915, and on December 21, 1915, was able to issue a printed bulletin containing detailed statistics of the industry for the calendar year 1915. This bulletin, which was very favorably received because of its timely appearance and valuable contents, was distributed to State legislators and fishery officials, to crab fishermen, dealers, and canners, and to all other interested persons.

In Maryland the growth of the hard-crab industry has been quite marked during the past few years, owing to the increasing number of firms engaged in shipping crab meat. The soft-crab fishery has scarcely more than held its own. The crab industry of this State in 1915 gave employment to 7,312 persons, of whom 4,053 were engaged in the shore or boat fisheries, 41 on fishing and transporting vessels, and 3,218 in the wholesale trade and canning industry. The invest-

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ment in vessels, boats, fishing apparatus, and shore and accessory property was $485,627. The wages paid in the wholesale and canning trades amounted to $191,840. The catch aggregated 90,281,646 crabs in number, or 30,093,882 pounds, valued at $664,651. This includes 22,491,675 pounds of hard crabs, valued at $335,375, and 7,602,207 pounds of soft crabs, valued at $329,276. The hard crabs were taken chiefly with trot lines, and smaller quantities with scrapes and scoop nets. The greater part of the catch of soft crabs was taken with scrapes and scoop nets, and the remainder with trot lines and seines.

Crisfield still remains the center of both soft and hard crab industries, about three-fourths of the entire crab catch of the State being handled and shipped from that place in a live condition or as crab meat. Many soft crabs are also brought here for shipment in the early spring from the western shore of Virginia. In 1915 there were 47 firms in Crisfield and immediate vicinity handling soft crabs only, 17 firms handling hard crabs only, 2 firms handling both soft and hard crabs, and 1 firm which canned soft crabs. Several of the soft-crab firms had branch houses at various localities throughout Somerset and Dorchester Counties, Md., and Accomac County, Va., their products being brought to Crisfield for shipment. Most of the crabs caught on the western shore of Maryland are also brought by gasoline boats to Crisfield for shipment. With the exception of a few shipped by steamer for consumption in Baltimore, practically all of the soft crabs are sent by express from Crisfield.

Somerset County leads all other counties in the production of crabs, the value of its output to the fishermen in 1915 amounting to $365,498, as compared with $130,136 for Dorchester, $106,480 for Talbot, $18,695 for Queen Anne, $14,210 for Anne Arundel, $12,385 for Kent, $4,900 for Calvert, $3,425 for St. Mary, $1,850 for Wicomico, $1,670 for Charles, and $1,000 for Baltimore. The value of the hard-crab industry far exceeds that of the soft-crab industry in all of the above counties except Somerset, where the conditions are reversed. All of the soft crabs except a few used for canning at Crisfield are shipped alive, while most of the hard crabs are utilized in the extraction of the meat, which is packed and shipped in tin buckets. There were only 3 firms in the State canning crabs in 1915, 2 of these handling hard and 1 soft crabs; the combined output of these firms was 179,976 cans, including a few glass jars, having a value of $33,759.

The crab industry of Virginia employed 2,978 persons and $367,150 in invested capital. The catch amounted to 60,748,158 crabs in number, or 20,249,386 pounds, valued at $317,156; of these, 18,765,148 pounds, valued at $242,754, were hard crabs, and the remainder, 1,484,238 pounds, valued at $74,402, were soft crabs. The most important apparatus used for crabs in Virginia is the trot line, which took 14,042,861 pounds, valued at $135,817; dredges are next, with a catch of 4,196,000 pounds, valued at $94,928; the remaining hard crabs were taken by means of scrapes and scoop nets. Scoop nets constitute the most important apparatus used in the soft-crab fishery, the catch with these amounted to 867,797 pounds, valued at $47,362; scrapes are next in importance with 616,441 pounds, valued at $27,040.

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Considering the relative importance of this industry by counties, Elizabeth City County ranks first with 5,040,840 pounds, valued at $78,533; Accomac County is next with 4,352,612 pounds, valued at $96,130. The former county has an excess of 688,228 pounds over the latter, but the value is $17,597 less. This is explained by the fact that Accomac County has quite an important soft-crab fishery, while Elizabeth City County has only hard crabs. The third in importance is York County, with 2,204,800 pounds, valued at $27,504; the fourth is Mathews County, with 1,997,760 pounds, valued at $18,221; the fifth is Norfolk County, with 1,959,000 pounds, valued at $21,772; the sixth is Northampton County, with 1,050,264 pounds, valued at $24,587. The remaining counties have less than 1,000,000 pounds each. Accomac County leads in the production of soft crabs, the catch this year being 1,150,996 pounds, valued at $50,645. Northumberland County leads the western-shore counties in the production of soft crabs, the catch amounting to 166,390 pounds, valued at $12,564; Lancaster County, the next in point of importance, shows a catch amounting to 78,720 pounds, valued at $5,928. Great Wicomico River region in the former county, and Corrotoman River, a branch of Rappahannock River, in the latter county, are regarded as quite productive and remunerative soft-crab waters, rendered more remunerative, probably, because of the fact that the soft crabs appear here earlier than on the eastern shore, in the Tangier Sound region, and the Crisfield dealers send boats over in the early spring for the catch.

Crab fishing usually starts in Northumberland and Lancaster Counties about the 15th or 20th of April, while the soft-crab season about Crisfield does not begin until about the middle of May. The catch, as well as the demand, diminishes about the early part of June, and many of the fishermen then seek other employment, although the Crisfield boats continue the trips practically throughout the season. These boats also call at other points on the western shore to make crab collections. Trot-line fishing is carried on with more or less importance in every county along both the eastern and western shores, but at many points on the latter side the fishermen lack good shipping facilities, the only outlet being to Baltimore by steamer, and crabs thus shipped from some places one morning do not reach their destination until the following morning. Many of the York County fishermen go to the lower part of the bay, where they consider the fishing grounds to be more productive, and sell their catch to Hampton. Some little trot-line fishing is carried on by Princess Anne County fishermen living about Lynnhaven Inlet. They start in Lynnhaven River in early spring, before the crabs begin moving about, and get good prices for their early catch, but when the Hampton fishermen begin fishing the price usually drops, and as the Lynnhaven fishermen are handicapped for want of convenient market they have about all abandoned crab fishing by early June. Hampton is, by far, the most important locality in the State for the crab industry, 33 of the 56 vessels hailing from this region. There are 15 wholesale dealers here, 2 of whom handle canned crab meat. These dealers take practically the entire catch of the dredge boats in addition to the trot-line catch of this (Elizabeth City) and other counties.

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Crabs are canned only during the summer months, and the crabs used for this purpose are consequently taken by trot lines. The line fishing begins as soon as the water becomes warm enough to cause the crabs to move from the mud in which they have been bedded for the winter for protection from the cold, usually some time in April or early May, and continues through the summer until the cold forces the crabs to again seek the mud bottom. In some sections, however, the line fishing slackens during the extremely hot summer months, this being especially true of those places where the shipping facilities are not favorable. The dredging season usually opens some time during November, usually about the middle of the month, as soon as the crabs have bedded, and extends throughout the winter until the water warms sufficiently to start the crabs from their winter beds. Dredging is mostly done in the lower part of the bay, and sometimes outside the capes when the sea is not too rough. The entire winter catch is picked and sold as fresh meat. Crab meat weighs 5 pounds to the gallon, and an average of 7 crabs will yield 1 pound of meat.

A table showing the details of the industry in Maryland and Virginia follows. There are given also comparative statistics of the catch for a number of years, beginning with 1880. The output in 1915 was the largest for any year for which data are available, and the value then was 50 per cent more than in 1908, the last previous year for which the Bureau had collected complete returns. The information at hand, however, points to a catch in 1915 much short of that a few years before, and the climax of the fishery seems to have been reached about 1912.

CRAB INDUSTRY OF MARYLAND AND VIRGINIA, 1915.

Items.	Maryland.		Virginia.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Persons engaged:						
On vessels fishing	33	.....	189	.....	222	.....
On vessels transporting	8	.....	.....	.....	8	.....
In shore or boat fisheries	4,053	.....	1,922	.....	5,975	.....
Shoresmen	3,218	.....	867	.....	4,085	.....
Total	7,312	.....	2,978	.....	10,290	.....
Vessels, boats, apparatus, and other property:						
Vessels fishing	16	$5,450	56	$139,100	72	$144,550
Net tonnage	94	.....	497	.....	591	.....
Vessels transporting	4	4,200	.....	.....	4	4,200
Net tonnage	26	.....	.....	.....	26	.....
Gasoline boats	1,304	181,475	283	61,160	1,587	242,635
Sail and row boats	3,053	119,245	1,693	28,774	4,746	148,019
Apparatus vessel fisheries:						
Dredges	.....	.....	182	4,511	182	4,511
Scrapes	71	183	18	54	99	237
Apparatus shore fisheries:						
Dredges	.....	.....	30	720	30	720
Scrapes	2,484	7,452	250	710	2,734	8,162
Scoop nets	1,770	874	641	317	2,411	1,191
Trot lines	1,525	8,741	1,139	7,449	2,664	16,190
Seines	29	111	.....	.....	29	111
Shore and accessory property	.....	157,896	.....	124,355	.....	282,251
Total	.....	485,627	.....	367,150	.....	852,777
Products:						
Vessel fisheries—						
With dredges—Hard crabs, pounds	.....	.....	3,596,400	81,246	3,596,400	81,246
With scrapes—						
Hard crabs.....pounds	26,962	577	11,804	265	38,766	842
Soft crabs.....do	85,772	3,875	52,332	2,355	138,104	6,230
Total	112,734	4,452	3,660,536	83,866	3,773,270	88,318

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Crab Industry of Maryland and Virginia, 1915—Continued.

Items.	Maryland.		Virginia.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Products—Continued.						
Shore fisheries—						
With dredges—Hard crabs, pounds			599,600	$13,682	599,600	$13,682
With scrapes—						
Hard crabs.....pounds..	1,444,435	$25,190	219,086	5,063	1,663,521	30,253
Soft crabs.....do....	3,601,394	152,626	564,109	24,685	4,165,503	177,311
With scoop nets—						
Hard crabs.....do....	1,100,422	20,908	295,397	6,681	1,395,819	27,589
Soft crabs.....do....	3,530,898	157,024	867,797	47,362	4,398,695	204,386
With trot lines—						
Hard crabs.....do....	19,919,856	288,700	14,042,861	135,817	33,962,717	424,517
Soft crabs.....do....	364,877	14,266	.....	.....	364,877	14,266
With seines—Soft crabs...do....	19,266	1,485	.....	.....	19,266	1,485
Total.....	29,981,148	660,199	16,588,850	233,290	46,569,998	893,489
Grand total.....	[a]30,093,882	664,651	[b]20,249,386	317,156	[c]50,343,268	981,807
Wholesale and canning trade:						
Wages.....	.....	191,840	.....	67,012	.....	258,852
Barrels, boxes, cans, and packing materials used.....	.....	104,529	.....	38,553	.....	143,082
Crabs canned.....cans..	.....	.....	.....	.....	478,104	91,465

[a] 90,281,646 in number. [b] 60,748,158 in number. [c] 151,029,804 in number.

Comparative Statistics of the Crab Product of Maryland and Virginia for Various Years from 1880 to 1915.

Years.	Maryland.					
	Crabs, hard.		Crabs, soft.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
1880	1,166,667	$46,850	(a)	(a)	1,166,667	$46,850
1887	2,757,638	36,969	1,636,530	$133,788	4,394,168	170,757
1888	2,674,675	37,438	2,208,829	161,331	4,883,504	198,769
1890	2,388,099	31,723	4,056,110	228,690	6,444,209	260,413
1891	2,776,898	37,460	4,828,872	266,256	7,605,770	303,716
1897	5,333,316	39,949	4,115,379	177,637	9,449,195	217,586
1901	9,824,793	85,884	4,303,582	202,563	14,128,375	288,447
1904	12,665,282	168,996	5,732,865	189,851	18,398,147	358,847
1908 [b]	12,786,000	124,000	7,587,000	195,000	20,373,000	319,000
1915	22,491,675	335,375	7,602,207	329,276	30,093,882	664,651

Years.	Virginia.						Grand total.	
	Crabs, hard.		Crabs, soft.		Total.			
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
1880	2,139,200	$32,088	(a)	(a)	2,139,200	$32,088	3,305,867	$78,938
1887	626,820	15,479	(a)	(a)	626,820	15,479	5,020,988	186,236
1888	956,843	24,669	(a)	(a)	956,843	24,669	5,840,347	223,438
1890	2,584,794	28,210	440,310	$26,054	3,025,104	54,264	9,469,313	314,677
1891	2,208,071	32,683	585,956	29,379	2,794,027	62,062	10,399,797	365,778
1897	5,331,398	28,331	1,068,116	39,914	6,399,514	68,245	15,848,709	285,831
1901	6,113,277	52,863	1,288,424	65,972	7,401,701	118,835	21,530,076	407,282
1904	10,356,052	179,575	1,910,654	92,909	12,266,706	272,484	30,664,853	631,331
1908 [b]	23,001,000	239,000	2,082,000	87,000	25,083,000	326,000	45,456,000	645,000
1915	18,765,148	242,754	1,484,238	74,402	20,249,386	317,156	50,343,268	981,807

[a] Statistics not available.
[b] The statistics for 1908 are from data published by the Bureau of the Census.

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SHAD AND ALEWIFE INDUSTRY OF CHESAPEAKE BAY AND TRIBUTARIES.

In view of the large interests dependent on the perpetuation of the supply of shad and alewives, or river herring, in the Chesapeake Basin, the Bureau in 1915 made a complete canvass of the industries connected with these fishes, for the purpose of being in position to substantiate the often expressed opinion that radical action was demanded of the States in order to prevent commercial extermination. The results of the canvass were promptly published in a statistical bulletin, which was at once sent to the governors and legislators of Maryland and Virginia, accompanied by three large charts showing the actual location of each pound net and gill net set for shad in 1915 on certain sections of the western shore of Virginia. The data thus supplied are thought to have influenced the Virginia Legislature, in its closing hours, to pass an act, effective in 1917, which will have the effect of permitting a larger portion of the run of spawning fish to reach their spawning grounds. This act, if its object is realized, will supplement in an effective way the protection that has heretofore been afforded to the migrating fish by the War Department through the insistence that certain lanes for navigational purposes shall be left in the maze of set nets on the shores of Chesapeake Bay and its major tributaries.

The fishery for alewives is closely connected with that for shad, the same apparatus being used and the seasons being coincident. The canvass therefore included the alewives as well as the shad, and the published bulletin, herein reprinted, gives the statistics of both fisheries.

The catch of shad in Maryland in 1915, compared with that of 1909, the latest previous year for which statistics are available, declined more than 50 per cent in quantity and about 29 per cent in value, and the catch of alewives decreased nearly 47 per cent in quantity and about 15 per cent in value. Chesapeake Bay, in Maryland, showed a decline of about 45 per cent in the shad catch and 31 per cent in the alewife catch. A still larger decrease occurred in some of the more important rivers. In the Susquehanna River, in Maryland and Pennsylvania, there was a decrease of 88 per cent in the shad and 88 per cent in the alewife catch. In the Choptank River and tributaries there was a decrease of 83 per cent in the catch of shad and 84 per cent in that of alewives. In the Potomac River the shad catch decreased 11 per cent and the alewife catch 74 per cent. In the Northeast River, which was the only one of importance which did not show a decided decline in these species, the catch of shad fell off less than 10 per cent and that of alewives increased 47 per cent.

The catch of shad in the Patuxent River in 1915 amounted to 1,118 in number, compared with 7,485 in 1909, 9,577 in 1904, 43,000 in 1901, and 52,354 in 1896, the only years for which statistics are available. The alewife catch fell off from 796,300 in 1909 to 20,400 in 1915.

The Elk River has never been a prolific shad stream, but has always furnished large quantities of alewives. The largest output of shad was in 1904, when 8,850 were taken. The catch of alewives in this river was 6,736,000 in 1909 and 3,608,950 in 1915.

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The decreased run of shad and alewives in the Chesapeake Bay basin of Maryland, Delaware, and Pennsylvania in 1915 resulted in a noticeable decline in the amount of all forms of apparatus used for their capture.

In Virginia the catch of shad in 1915, compared with 1909, decreased 1,316,066 pounds, or 21.82 per cent in quantity, but increased $169,674, or 34.74 per cent, in value, and the catch of alewives decreased 11,733,850 pounds, or 42.22 per cent in quantity, and increased $37,575, or 29.26 per cent, in value.

The pound nets fished in Virginia in these waters during the season of 1915, compared with 1909, show a decrease of 31, but the number of gill nets increased from 7,121 in 1909 to 16,793 in 1915. The total catch of shad in Virginia during the year was 1,629,872 in number, or 4,714,134 pounds, valued at $658,010, and that of alewives was 40,135,328 in number, or 16,054,130 pounds, valued at $165,950.

In the Potomac River there were but two seines fished during the season of 1915 for herring and shad—one on the Maryland side at Chapmans Point and the other on the Virginia side at Stony Point. There are very few pound nets along the Maryland side of this river, but quite a number of large traps on the Virginia side off Northumberland County near the mouth. The alewife fisheries of Westmoreland County were quite extensive up to a few years ago, and it was in this county that the canning of the roe originated. Several large packing houses were located in this county as recently as 1909, but now there is but one, and that very small. There are a number of large packing houses in that part of Northumberland County bordering on the Potomac, or rather in Coan River and Yeocomico River, which are tributary to the Potomac. Both alewives and roe are packed in large quantities at these points. Drift gill nets are not fished for shad below Maryland Point, and from this place they are used in various locations up to Jones Point, a short distance below Alexandria. The gill-net catch of 1915 was reported by fishermen as the lightest they had ever taken, and many of them made little more than expenses. Some fishermen of Northumberland County along the Potomac reported the herring and shad catch for 1915 as very gratifying and thought that it was the best they have had for several seasons.

The total number of pound nets fished in Virginia during the year was 2,012, valued at $408,675. Of these, 527, or about 26 per cent, valued at $107,200, were fished by Mathews County fishermen. Elizabeth City County ranks second in the number of pound nets, having 317, valued at $73,900; Accomac County third, with 273 nets, valued at $48,150; followed by Northumberland County with 269, valued at $73,250, and Gloucester County with 204, valued at $33,100.

The catch for 1915 showed a great many more bucks than for the average year, and many of these were smaller than usual. This seemed to be the case on all parts of the bay.

In the James River stake gill nets are the leading form of apparatus used for shad fishing. The only drifting grounds remaining are located quite a distance up the river, and the catch with drift nets was negligible in the 1915 season. During the summer of 1909, when a canvass of the shad fisheries was made on this river, very few stake nets were found above Ferguson's Wharf, now called Rushmere, located in Isle of Wight County about 12 miles above Newport News.

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Such nets are now found at various points up as far as Tar Bay, near Coggins Point, within a short distance of the mouth of Appomattox River. The shad run appeared in 1915 about March 15 to 20, though a few stray fish were seen earlier, and the gill-net fishing was practically over by the third or fourth week in May. Gill nets can not be used after the water is warm enough to start the crabs, as these hang in the nets and interfere too much with the handling of them. The run was much lighter than usual, but the greater part of the gill-net catch was roe fish, and the high price received partly made up for the decrease in the catch.

The apparatus used in the Chickahominy River consists entirely of seines and drift gill nets, and the catch includes shad and other species. Pound nets are not permitted in this river.

In the Rappahannock River stake gill nets having 2¾-inch mesh are fished during the winter for perch and discontinued when the shad season opens. The shad nets are then used on the same stands, being the same length as the perch nets but of a larger mesh. Herring do not usually figure in the catch of the perch nets, but there was an early run of branch herring in 1915 and some of the nets made fairly good catches. The fishermen received as high as $20 per thousand for these early herring. Some herring are caught also in the small pound nets in this river, and the average price for these was about $10 per thousand.

The number of persons engaged in the shad and alewife industries of Chesapeake Bay and tributaries in 1915 was 8,839, of whom 6,612 were fishermen and 2,227 were employed in shore industries. The investment in boats, fishing apparatus, shore and accessory property, and cash capital amounted to $1,528,824. The products of these fisheries aggregated 2,129,486 shad in number, or 6,225,549 pounds, valued at $857,771, and 71,571,278 alewives in number, or 28,628,510 pounds, valued at $297,899, a total value for both species of $1,155,670. Compared with the returns for 1909, there was a decrease of 258 in the number of pound nets and an increase of 7,968 in the number of gill nets operated. The catch of shad decreased 3,114,219 pounds, but increased $88,322 in value, and the catch of alewives decreased 22,803,590 pounds and increased $13,855 in value.

Statistics by States of the shad and alewife industry of Chesapeake Bay and tributaries in 1915, and also comparative statistics for Maryland and Virginia for various years from 1880 to 1915, and by waters for certain years from 1896 to 1915, are given in detail in the following tables.

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SHAD AND ALEWIFE INDUSTRY OF CHESAPEAKE BAY AND TRIBUTARIES, 1915.

Items.	Pennsylvania.			Delaware.			Maryland.			Virginia.			Total.		
	Number.	*Pounds.*	*Value.*	*Number.*	*Pounds.*	*Value.*	*Number.*	*Pounds.*	*Value.*	*Number.*	*Pounds.*	*Value.*	*Number.*	*Pounds.*	*Value.*
Persons engaged:															
Fishermen	192			70			2,388			3,962			6,612		
Shoresmen							1,034			1,193			2,227		
Total	192			70			3,422			5,155			8,839		
Boats, apparatus, and other property:															
Gasoline boats							[a] 559		$147,510	659		$230,080	1,218		$377,590
Sail and row boats	110		$1,360	33		$400	[b] 555		19,723	1,091		20,355	1,789		41,838
Apparatus—															
Pound nets							1,062		161,920	2,012		408,675	3,074		570,595
Stake gill nets							2,172		6,209	16,267		16,325	18,439		22,534
Drift and anchored gill nets				68		912	1,703		33,293	526		14,333	2,297		48,538
Seines	8		660	2		400	17		7,925	8		3,795	35		12,780
Dip nets	150		300				53		230				203		530
Shore and accessory property									121,622			125,197			246,819
Cash capital									35,000			172,600			207,600
Total			2,320			1,712			533,432			991,360			1,528,824
Products:															
With pound nets—															
Shad							312,182	908,635	118,395	1,347,482	3,782,574	523,670	1,659,664	4,691,209	642,065
Alewives (herring)							23,874,350	9,549,740	105,849	39,653,000	15,861,200	160,762	63,527,350	25,410,940	266,611
With stake gill nets—															
Shad							21,320	70,075	9,612	158,605	534,508	77,599	179,925	604,583	87,211
Alewives (herring)										99,900	39,960	1,998	99,900	39,960	1,998
With drift and anchored gill nets—															
Shad				7,850	25,000	3,590	130,332	422,539	57,251	118,381	380,922	54,479	256,563	828,461	115,320
Alewives (herring)							90,000	36,000	475	250,000	100,000	2,500	340,000	136,000	2,975
With seines—															
Shad	6,100	18,300	2,650	1,100	3,080	429	10,299	32,289	3,394	5,404	16,130	2,262	22,903	69,799	8,735
Alewives (herring)				17,000	6,800	170	7,454,600	2,981,840	25,455	132,428	52,970	690	7,604,028	3,041,610	26,315
With dip nets—shad	3,000	10,500	1,575				7,431	20,997	2,865				10,431	31,497	4,440
Total shad	9,100	28,800	4,225	8,950	28,080	4,019	481,564	1,454,535	191,517	1,629,872	4,714,134	658,010	2,129,486	6,225,549	857,771
Total alewives (herrings)				17,000	6,800	170	[c] 31,418,950	12,567,580	131,779	40,135,328	16,054,130	165,950	71,571,278	28,628,510	297,899
Grand total			4,225			4,189			323,296			823,960			1,155,670

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Wholesale and canning trade:															
Wages									34,195			31,691			65,886
Barrels, boxes, cans, and salt used									32,378			55,969			88,347
Salt alewives (herring), barrels						20,227	4,091,400	103,278	35,958	7,191,600	158,895	56,185	11,283,000	262,173	
Corned alewives (herring)						1,624,300	649,720	8,844	7,237,700	2,895,080	45,162	8,862,000	3,544,800	54,006	
Canned alewives (herring), cans						27,144	24,093	1,331				27,144	24,093	1,331	
Canned alewives (herring) roe.....cans						351,888	374,404	34,046	839,160	944,055	83,321	1,191,048	1,318,459	117,367	

[a] Includes one steamer valued at $2,500.
[b] Includes 3 vessels of 24 net tons, valued at $2,450, used as house-boats.
[c] 4,364,950, weighing 1,745,980 pounds, valued at $33,492, were salted, and 30,000, weighing 12,000 pounds, valued at $175, were smoked by the fishermen.

Comparative Statistics of the Shad and Alewife Product of Maryland and Virginia for Various Years from 1880 to 1915.[a]

Years.	Maryland.					Virginia.					Grand total.			
	Shad.		Alewives.		Total value.	Shad.		Alewives.		Total value.	Shad.		Alewives.	
	Pounds.	*Value.*	*Pounds.*	*Value.*		*Pounds.*	*Value.*	*Pounds.*	*Value.*		*Pounds.*	*Value.*	*Pounds.*	*Value.*
1880	3,774,426	$140,926	9,203,959	$139,667	$280,593	3,171,953	$134,496	6,925,413	$76,300	$210,796	6,946,379	$275,422	16,129,372	$215,967
1887	4,040,820	146,951	11,062,270	89,273	236,234	3,815,126	172,272	4,401,635	29,585	201,857	7,855,946	319,223	15,463,905	118,858
1888	4,868,435	176,655	11,511,774	110,291	286,946	7,056,473	321,634	6,453,005	40,369	362,003	11,924,908	498,289	17,964,779	150,660
1890	7,127,486	242,909	19,766,994	143,793	386,702	7,266,207	228,897	10,641,698	91,674	320,571	14,393,693	471,806	30,408,692	235,467
1891	6,224,873	211,575	17,418,850	131,245	342,820	6,498,242	207,394	11,013,485	93,905	301,299	12,723,115	418,969	28,432,335	225,150
1896	5,541,499	166,551	17,667,315	126,050	292,601	11,170,519	307,055	12,197,607	63,024	370,079	16,712,018	473,606	29,864,922	189,074
1897	5,799,563	159,365	17,139,459	123,453	282,818	11,529,474	304,448	13,689,510	70,841	375,289	17,329,037	463,813	30,828,969	194,294
1901	3,111,181	120,602	13,747,157	91,308	211,910	6,972,212	366,203	13,913,444	115,424	481,627	10,083,393	486,805	27,660,601	206,732
1904	2,912,249	159,772	14,484,970	137,982	297,754	7,419,899	439,625	14,603,866	90,733	530,358	10,332,148	599,397	29,088,836	228,715
1908 [b]	3,937,000	247,000	28,805,000	157,000	404,000	7,314,000	486,000	37,885,000	171,000	657,000	11,251,000	733,000	66,690,000	328,000
1909	3,252,688	272,869	23,637,320	155,499	428,368	6,030,200	488,336	27,787,980	128,375	616,711	9,282,888	761,205	51,425,300	283,874
1915	1,454,535	191,517	12,567,580	131,779	323,296	4,714,134	658,010	16,054,130	165,950	823,960	6,168,669	849,527	28,621,710	297,729

[a] The catch of shad and alewives in these States outside of the Chesapeake Bay region is included for some years, but is practically negligible.
[b] The statistics for 1908 in this table are from data published by the Bureau of the Census.

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COMPARATIVE STATISTICS OF THE APPARATUS USED IN THE SHAD AND ALEWIFE FISHERIES OF MARYLAND AND VIRGINIA FOR VARIOUS YEARS FROM 1891 TO 1915.

Years.	Maryland.												Virginia.									
	Pound nets.		Gill nets.		Seines.		Fyke nets.		Dip nets.		Traps.		Pound nets.		Gill nets.		Seines.		Fyke nets.		Traps.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
1891	625	$59,510	10,254	$90,650	214	$36,650	.....	.....	.....	.....	.....	.....	708	$133,880	6,287	$39,464	27	$18,510	.....	.....	.....	.....
1896	901	66,816	6,593	53,996	90	25,816	335	$5,223	128	$625	15	$600	1,156	236,680	10,748	36,947	42	19,005	72	$1,032	22	$805
1909	1,289	.....	5,620	.....	29	.....	34	.....	65	.....	6	.....	2,043	.....	7,121	.....	16	.....	7	.....	18	.....
1915	1,062	161,920	3,875	39,502	17	7,925	.....	.....	53	230	.....	.....	2,012	408,675	16,793	30,658	8	3,795	.....	.....	.....	.....

CATCH OF SHAD AND ALEWIVES IN CHESAPEAKE BAY AND ITS SEVERAL TRIBUTARIES FOR CERTAIN YEARS FROM 1896 TO 1915, BY WATERS.

Waters.	Shad.										Alewives.			
	1896		1901		1904		1909		1915		1909		1915	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Chesapeake Bay:														
Virginia	1,122,225	$109,749	[a]1,052,180	$199,355	[a]1,525,137	$330,073	1,117,328	$278,789	1,130,116	$440,756	38,037,440	$68,506	30,475,100	$122,749
Maryland	417,857	47,465	311,360	44,395	473,860	98,095	580,207	149,187	321,378	128,293	26,222,500	66,203	18,083,300	69,125
Total	1,540,082	157,214	1,363,540	243,750	1,998,997	428,168	1,697,535	427,976	1,451,494	569,049	64,259,940	134,709	48,558,400	191,874
James River and tributaries	495,762	51,247	311,231	61,868	265,664	57,463	216,748	73,108	205,835	98,621	563,487	2,479	122,000	610
York River and tributaries	546,548	50,361	.....	.....	.....	.....	132,139	32,788	22,443	10,341	3,259,167	6,829	43,000	172
Mobjack Bay	140,777	13,874	.....	.....	.....	.....	49,657	11,748	7,563	2,865	1,001,015	2,267	116,000	464
Piankatank River	.....	.....	.....	.....	.....	.....	1,050	250	.....	.....	37,000	67	.....	.....
Rappahannock River	417,789	35,371	.....	.....	.....	.....	94,935	22,486	50,636	21,444	968,800	1,900	687,900	5,554
Potomac River:														
Virginia	450,825	43,084	648,462	104,566	289,500	51,709	172,813	44,500	165,206	65,300	24,601,040	42,854	7,276,428	30,741
Maryland	233,238	20,524	146,000	14,800	83,147	16,343	31,158	9,232	17,196	6,827	4,883,000	10,369	335,000	1,420
Total	684,063	63,608	794,462	119,366	372,647	68,052	203,971	53,732	182,402	72,127	29,484,040	53,223	7,611,428	32,161
Patuxent River	52,354	5,867	43,000	6,941	9,577	2,483	7,485	2,106	1,118	415	796,300	3,192	20,400	149
West River	.....	.....	8,200	1,050	3,750	962	.....	.....	.....	.....	.....	.....	.....	.....
South River	.....	.....	470	60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Severn River	.....	.....	27,500	4,259	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Magothy River	.....	.....	.....	.....	.....	.....	22	7	.....	.....	100,000	290	.....	.....
Patapsco River	.....	.....	1,900	160	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Back River	.....	.....	.....	.....	.....	.....	20	6	.....	.....	62,000	124	.....	.....
Middle River	.....	.....	235	50	.....	.....	.....	.....	.....	.....	7,500	17	.....	.....

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Gunpowder River			850	177			16	5			57,000	137		
Bush River					866	180	206	82	70	25	442,500	1,327	705,000	1,565
Susquehanna River:														
Maryland	69,488	8,157	67,000	8,874	39,275	8,087	65,717	19,379	6,585	2,359	8,741,500	33,735	1,070,000	3,870
Pennsylvania	70,599	11,996	98,883	23,412	76,521	19,867	60,045	22,224	9,100	4,225	25,000	75		
Total	140,087	20,153	165,883	32,286	115,796	27,954	125,762	41,603	15,685	6,584	8,766,500	33,810	1,070,000	3,870
Northeast River	60,620	6,382	(b)	(b)	(b)	(b)	62,375	14,627	56,247	21,917	3,740,000	9,500	5,504,000	27,105
Elk River	5,244	637	4,000	478	8,850	1,600	1,053	287	1,426	524	6,736,000	11,251	3,608,950	18,194
Sassafras River	1,290	166	2,500	298	8,150	1,592	329	91	386	150	3,527,000	10,285	1,125,000	6,170
Chester River	53,507	7,918	4,475	739	4,215	1,010	5,718	1,711	1,565	574	646,500	1,771	243,000	1,057
St. Michaels River	2,215	423												
Eastern Bay							5,743	1,699	2,755	991	269,500	462	95,000	355
Choptank River and tributaries	338,420	35,810	142,297	20,918	40,267	8,237	108,956	32,725	17,960	7,016	2,072,000	4,771	336,000	1,596
Honga River			1,555	266	718	148								
Fishing Bay	9,790	1,174	6,000	905	10,980	1,801	800	240			4,000	20		
Blackwater River	13,160	1,480	2,125	290	2,088	497	2,800	840			116,000	232		
Transquaking River	13,694	1,287	4,100	553	5,618	899	9,900	2,970			33,000	83		
Nanticoke River:														
Maryland	125,181	11,648	34,985	5,977	31,028	7,308	21,945	6,583	8,740	4,005	105,727	271	3,000	12
Delaware	52,467	5,155	37,097	6,315	22,450	5,321	7,700	2,310	8,950	4,019	30,000	90	17,000	170
Total	177,648	16,803	72,082	12,292	53,478	12,629	29,645	8,893	17,690	8,024	135,727	361	20,000	182
Marshyhope Creek	38,660	3,865	(c)	(c)	(c)	(c)								
Wicomico River	68,015	8,480	34,348	4,500	28,370	5,946	14,475	4,242	2,374	1,092	28,000	216		
Manokin River					16	5								
Pocomoke:														
Virginia			2,137	414	1,550	380	5,600	1,960			55,000	412		
Maryland	29,752	4,304	28,575	4,004	13,995	3,179	24,130	8,445	9,734	3,977	30,000	75		
Total	29,752	4,304	30,712	4,418	15,545	3,559	29,730	10,405	9,734	3,977	85,000	487		
Tangier Sound:														
Virginia	21,257	2,422					49,776	17,317	42,916	16,743	642,000	1,685	1,311,400	5,246
Maryland	1,416	163	800	155	1,090	153	55,272	17,530	32,065	12,578	418,273	1,032	250,300	1,001
Total	22,673	2,585	800	155	1,090	153	105,048	34,847	74,981	29,321	1,060,273	2,717	1,561,700	6,247
Pocomoke Sound:														
Virginia	8,320	947					15,400	5,390	5,157	1,940	305,000	1,376	103,500	414
Maryland	7,149	801	2,900	560	5,360	814	2,500	875	1,965	774	55,000	136	40,000	160
Total	15,469	1,748	2,900	560	5,360	814	17,900	6,265	7,122	2,714	360,000	1,512	143,500	574
Grand total	4,867,619	490,757	3,025,165	516,339	2,952,042	624,152	2,924,018	785,739	2,129,486	857,771	128,618,249	284,039	71,571,278	297,899

a Includes all tributaries of Chesapeake Bay except the James, Potomac, and Pocomoke Rivers. b Included with Chesapeake Bay. c Included with Nanticoke River.

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NUMBER OF POUND NETS, THE CATCH OF SHAD AND ALEWIVES, AND THE AVERAGE CATCH OF EACH SPECIES PER NET FOR CERTAIN SECTIONS OF CHESAPEAKE BAY AND POTOMAC RIVER, 1915.

Locality.	Number of pound nets.	Number of shad.	Number of alewives.	Average number of shad to net.	Average number of alewives to net.
From Cape Henry to Tue Point (lower side of York River mouth)	496	268,374	1,974,490	541	3,980
From York Spit (inclusive) to Stingray Point	623	491,196	4,437,345	772	7,122
From Rappahannock Spit (inclusive) to Smith Point	276	291,266	21,667,166	1,054	78,504
Potomac River	211	147,271	7,336,000	697	34,760

COASTAL FISHERIES OF NEW YORK AND NEW JERSEY.

Following a conference with the fishery authorities of the States of New York and New Jersey in January, 1916, regarding the condition of the coastal fisheries of those States and the measures necessary for their conservation, the Bureau undertook, by request, the canvass of those fisheries so that their actual extent might be known. The field work was completed in June and the results of the canvass were communicated to those interested. The figures related to the calendar year 1915 and covered only fishes proper.

In New York the number of persons engaged in the coastal fisheries was 2,504, and the investment in vessels, boats, fishing apparatus, and shore and accessory property was $1,771,166. The products amounted to 34,047,775 pounds of fish, valued at $1,121,641. Some of the more important species taken were bluefish, 6,107,113 pounds, valued at $492,928; butterfish, 1,244,475 pounds, valued at $51,636; cod, 1,259,160 pounds, valued at $59,400; eels, 426,330 pounds, valued at $34,387; flounders, 3,440,053 pounds, valued at $96,337; mackerel, 342,489 pounds, valued at $25,620; menhaden, 14,518,812 pounds, valued at $100,935; scup, 1,026,736 pounds, valued at $44,447; sea bass, 973,686 pounds, valued at $44,894; and squeteague, 1,859,143 pounds, valued at $98,324.

In New Jersey there were 2,303 persons employed in the coastal fisheries, and the investment amounted to $1,192,057. The products aggregated 47,856,176 pounds of fish, valued at $1,348,667. The species taken in largest quantities were bluefish, 2,728,779 pounds, valued at $177,906; butterfish, 5,462,917 pounds, valued at $151,677; cod, 679,133 pounds, valued at $31,896; croaker, 2,084,719 pounds, valued at $47,366; eels, 377,698 pounds, valued at $28,257; flounders, 1,531,376 pounds, valued at $58,443; mackerel, 367,307 pounds, valued at $26,161; menhaden, 4,354,789 pounds, valued at $36,602; scup, 3,279,693 pounds, valued at $94,776; sea bass, 6,171,922 pounds, valued at $203,163; squeteague, 14,121,330 pounds, valued at $358,977; and whiting, 2,407,217 pounds, valued at $36,367.

The statistics of these fisheries, by counties, are given in detail in the following table:

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STATISTICS OF COASTAL FISHERIES OF NEW YORK AND NEW JERSEY, BY COUNTIES, EXCLUSIVE OF SHELLFISH, 1915.

NEW YORK.

Items.	Kings, New York, Queens, and Richmond Counties.		Nassau County.		Suffolk County.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Persons engaged	841		119		1,544		2,504	
Vessels fishing	57	$306,395	4	$5,850	84	$763,896	145	$1,076,141
Tonnage	2,576		32		2,371		4,979	
Outfit		145,225		620		49,256		195,101
Vessels transporting					21	52,720	21	52,720
Tonnage					266		266	
Outfit						2,240		2,240
Sail, row, and house boats	11	225	39	890	474	16,160	524	17,275
Gasoline boats	4	2,850	34	14,750	282	112,025	320	129,625
Pound nets	4	2,800			460	114,215	464	117,015
Seines	20	17,900	23	1,173	117	37,010	160	56,083
Gill nets	100	1,100	84	3,375	469	11,670	653	16,145
Fyke nets					5,373	24,152	5,373	24,152
Lines		4,500		635		1,838		6,973
Otter trawls					156	3,815	156	3,815
Eelpots	250	275	390	430	5,055	5,503	5,695	6,208
Other apparatus				2,276		112		2,388
Shore and accessory property		650		1,050		63,585		65,285
Total		481,920		31,049		1,258,197		1,771,166
Products:								
Albacore and horse mackerel	*Pounds.* 430	*Value.* $25	*Pounds.*	*Value.*	*Pounds.* 4,450	*Value.* $129	*Pounds.* 4,880	*Value.* $154
Alewives	11,000	140	500	$10	523,605	7,214	535,105	7,364
Bluefish	5,790,205	466,522	27,200	2,690	289,708	23,716	6,107,113	492,928
Bonito	1,054	100	300	30	11,795	1,157	13,149	1,287
Butterfish	60,000	1,800			1,184,475	49,836	1,244,475	51,636
Carp					102,300	7,592	102,300	7,592
Cod	723,375	32,855	201,000	9,550	334,785	16,995	1,259,160	59,400
Croaker	14,949	336			10,000	350	24,949	686
Eel	5,630	532	32,900	3,395	387,800	30,460	426,330	34,387
Flounders	28,123	838	115,000	3,240	3,296,930	92,259	3,440,053	96,337
Haddock	34,041	1,238	2,000	100	49,550	2,573	85,591	3,911
Hake	2,044	63	8,500	200	52,725	1,238	63,269	1,501
Hog choker					7,200	60	7,200	60
Kingfish	89	18			31,005	3,170	31,094	3,188
Mackerel	9,360	968	6,800	630	326,329	24,022	342,489	25,620
Menhaden	2,632,100	19,307	6,000	60	11,880,712	81,568	14,518,812	100,935
Mullet, fresh					5,113	203	5,113	203
Mummichog			8,000	40	138,250	1,023	146,250	1,063
Pike					800	96	800	96
Pollock	16,170	529	30,000	900	35,540	1,465	81,710	2,894
Scup, or porgy	511,476	20,574			515,260	23,873	1,026,736	44,447
Sea bass	270,263	14,398	150,000	2,500	553,423	27,996	973,686	44,894
Sea robins	2,657	29			97,905	1,251	100,562	1,280
Shad	5,250	785			14,705	1,365	19,955	2,150
Sharks	20,975	84			19,225	192	40,200	276
Skates	7,700	77			204,463	1,360	212,163	1,437
Smelt			2,300	350	4,450	1,320	6,750	1,670
Spanish mackerel	529	162	50	10	20	2	599	174
Spot					1,500	60	1,500	60
Squeteague	592,254	22,477	56,950	3,022	1,209,939	72,825	1,859,143	98,324
Squid	1,200	12			556,425	8,306	557,625	8,318
Striped bass			2,200	344	14,700	2,460	16,900	2,804
Sturgeon					3,826	673	3,826	673
Sturgeon caviar					241	248	241	248
Swellfish					50,225	370	50,225	370
Swordfish					7,362	756	7,362	756
Tautog	881	38	100	5	98,100	3,989	99,081	4,032
Tilefish	[a] 183,484	7,748					183,484	7,748
Tomcod					70,157	2,716	70,157	2,716
White bait					28,200	2,220	28,200	2,220
White perch					19,400	2,038	19,400	2,038
Whiting	1,000	10			328,925	3,742	329,925	3,752
Other fish					213	12	213	12
Total	10,926,239	591,665	649,800	27,076	22,471,736	502,900	34,047,775	1,121,641

[a] Landed by New York vessels and does not include tilefish landed at New York by vessels from other ports.

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STATISTICS OF COASTAL FISHERIES OF NEW YORK AND NEW JERSEY, BY COUNTIES, EXCLUSIVE OF SHELLFISH, 1915—Continued.

NEW JERSEY.

Items.	Atlantic County.		Bergen and Hudson Counties.[a]		Cape May County.		Middlesex County.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Persons engaged	298		43		680		54	
Vessels fishing	19	$71,485			25	$74,690		
Tonnage	349				330			
Outfit		25,130				32,725		
Vessels transporting	2	3,500			1	50		
Tonnage	15				10			
Outfit		45						
Sail, row, and house boats	63	1,720	16	$742	38	480	21	$900
Gasoline boats	34	12,250	4	900	130	69,600	8	2,400
Pound nets	3	1,950			58	128,325	1	600
Seines	42	1,722	5	215	21	3,988	10	4,175
Gill nets	45	1,785	10	1,315	192	15,912		
Fyke nets	11	460	26	400	48	2,050	4	200
Bag nets	15	375						
Lines		624		10		3,186		
Eelpots	50	45	4	6	202	325	98	98
Other apparatus				75				
Shore and accessory property		2,420		1,436		38,840		550
Total		123,511		5,099		370,171		8,923
Products:								
Albacore and horse mackerel	*Pounds.* 800	*Value.* $11	*Pounds.*	*Value.*	*Pounds.* 10,220	*Value.* $172	*Pounds.*	*Value.*
Alewives	13,862	329	300	$30	29,500	474	7,500	$100
Bluefish	163,664	12,004			874,335	55,620	18,900	915
Bonito	800	48			17,469	857		
Butterfish	49,205	1,041			2,166,453	61,712		
Carp			10,650	1,157			12,500	1,100
Cod	201,000	9,330			261,870	12,842		
Croaker	297,278	6,488			1,063,735	24,515		
Drum	480	5			5,550	63		
Eel	5,875	419	8,025	670	42,885	4,669	1,800	127
Flounders	68,744	2,728			318,044	11,748	4,400	197
Haddock					200	10		
Hake	200	3			1,249	37		
Kingfish	24,068	2,150			17,429	1,925		
Mackerel	152,125	10,860			148,232	10,509		
Menhaden	1,200,000	14,000			101,381	598	112,569	236
Mullet, fresh	5,500	103			34,750	990		
Mullet, salted					500	50		
Pollock					325	4		
Scup, or porgy	840,400	25,109			1,887,117	53,090		
Sea bass	1,522,238	49,280			3,943,624	123,796		
Shad	115	19	20,104	2,674	170	20	1,705	312
Sharks					10,198	143		
Skates	1,200	11			89,180	911		
Smelt							6,000	1,200
Spanish mackerel					270	39		
Spot	4,175	132			13,085	304	2,000	60
Squeteague	1,634,099	42,613			4,331,759	122,331	88,200	3,013
Squid	500	6			289,826	3,617		
Striped bass	7,080	1,384					200	25
Sturgeon					65	4		
Suckers	3,550	226	15,000	1,645				
Tautog	600	12			760	19		
White perch	27,159	2,373			1,575	145	75	6
Whiting					2,000	33		
Yellow perch	165	15			450	22		
Other fish	1,200	83	5,035	495	180	19		
Total	6,226,082	180,782	59,114	6,671	15,664,386	491,288	255,849	7,291

[a] Includes men, boats, apparatus, and shore property employed and catch of fish taken in Upper New York Bay and Hackensack River, and also men, boats, apparatus, and shore property employed and catch of shad taken in Hudson River.

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STATISTICS OF COASTAL FISHERIES OF NEW YORK AND NEW JERSEY, BY COUNTIES, EXCLUSIVE OF SHELLFISH, 1915—Continued.

NEW JERSEY—Continued

Items.	Monmouth County.		Ocean and Burlington Counties.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Persons engaged	582		646		2,303	
Vessels fishing	3	$7,300	1	$1,500	48	$154,975
Tonnage	38		6		723	
Outfit		3,900		80		61,835
Vessels transporting	2	11,000			5	14,550
Tonnage	21				46	
Outfit		1,450				1,495
Sail, row, and house boats	67	1,655	206	10,436	411	15,933
Gasoline boats	179	78,150	154	55,100	509	218,400
Pound nets	65	83,090	47	127,800	174	341,765
Seines	8	2,440	46	2,410	132	14,950
Gill nets	155	8,050	1,359	10,626	1,761	37,688
Fyke nets	103	1,430	778	5,660	970	10,200
Bag nets			75	1,900	90	2,275
Lines		2,327		725		6,872
Otter trawls			1	20	1	20
Eelpots	1,424	1,822	3,461	2,685	5,239	4,981
Other apparatus		7		30		112
Shore and accessory property		118,725		144,035		306,006
Total		321,346		363,007		1,192,057
Products:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Albacore and horse mackerel	14,255	$654	44,987	$1,095	70,262	$1,932
Alewives	214,270	2,153	351,865	3,779	617,297	6,865
Bluefish	1,402,898	87,697	268,982	21,670	2,728,779	177,906
Bonito	23,175	1,908	75,878	6,291	117,322	9,104
Butterfish	711,881	22,297	2,535,378	66,627	5,462,917	151,677
Carp					23,150	2,257
Cod	122,908	5,697	93,355	4,027	679,133	31,896
Croaker	288,080	7,178	435,626	9,185	2,084,719	47,366
Drum	8,600	86			14,630	154
Eel	131,238	9,161	187,875	13,211	377,698	28,257
Flounders	373,415	15,297	766,773	28,473	1,531,376	58,443
Goosefish	40,000	125			40,000	125
Haddock					200	10
Hake	727,493	9,305	439,683	4,638	1,168,625	13,983
Hickory shad	3,500	165			3,500	165
Kingfish	5,910	904	13,190	2,188	60,597	7,167
Mackerel	50,175	3,490	16,775	1,302	367,307	26,161
Menhaden	2,765,830	20,142	175,009	1,626	4,354,789	36,602
Mullet, fresh	22,750	910			63,000	2,003
Mullet, salted					500	50
Pollock	3,500	111	8,999	267	12,824	382
Round herring	35,432	717			35,432	717
Scup, or porgy	164,950	5,992	387,226	10,585	3,279,693	94,776
Sea bass	327,800	16,339	378,260	13,748	6,171,922	203,163
Sea robins	35,500	425	41,375	620	76,875	1,045
Shad	12,813	2,183	7,230	1,060	42,137	6,268
Sharks	84,550	748	17,800	175	112,548	1,066
Skates	272,470	1,600	150,716	857	513,566	3,379
Smelt					6,000	1,200
Spanish mackerel	164	34	621	109	1,055	182
Spot	18,950	431	28,450	740	66,660	1,667
Squeteague	3,055,048	86,973	5,012,224	104,047	14,121,330	358,977
Squid	157,370	2,125	525,975	7,082	973,671	12,830
Striped bass	220	44	7,148	1,770	14,648	3,223
Sturgeon	2,788	435	500	50	3,353	489
Sturgeon caviar	270	272			270	272
Suckers			8,700	586	27,250	2,457
Tautog	40,650	1,772	3,000	105	45,010	1,908
Tilefish	30	3			30	3
Toadfish	5,800	80			5,800	80
White bait	750	33			750	33
White perch			136,130	12,881	164,939	15,405
Whiting	1,754,995	26,636	650,222	9,698	2,407,217	36,367
Yellow perch					615	37
Other fish			365	21	6,780	618
Total	12,880,428	334,122	12,770,317	328,513	47,856,176	1,348,667

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SHAD FISHERY OF THE HUDSON RIVER.

In connection with the canvass of the coastal fisheries of New York and New Jersey the shad fishery of the Hudson River was covered for the years 1915 and 1916. The statistics are given in the following table, showing for the latter year 119 fishermen, 79 gill nets, 3 seines, and a catch of 9,287 shad, valued at $5,465. The Hudson was at one time one of the great shad streams, its annual output running into the hundreds of thousands. Thus, in 1896 the number of shad taken was 588,898, valued at $83,237. The present condition of the shad fishery is most deplorable.

SHAD FISHERY OF THE HUDSON RIVER, 1915 AND 1916.[a]

1915.

Items.	New York.			New Jersey.			Total.		
	No.	*Lbs.*	*Value.*	*No.*	*Lbs.*	*Value.*	*No.*	*Lbs.*	*Value.*
Fishermen	133	.....	.....	27	.....	.....	160	.....	.....
Sail and row boats	81	.....	$2,975	7	.....	$430	88	.....	$3,405
Gasoline boats	2	.....	225	2	.....	600	4	.....	825
Gill nets	79	.....	3,984	7	.....	1,035	86	.....	5,019
Seines	2	.....	190	.....	.....	.....	2	.....	190
Shore and accessory property	.....	.....	528	.....	.....	1,230	.....	.....	1,758
Total	.....	.....	7,902	.....	.....	3,295	.....	.....	11,197
Shad caught:									
With gill nets	11,333	47,333	5,834	4,249	20,104	2,674	15,582	67,437	8,508
With seines	62	298	33	.....	.....	.....	62	298	33
With other apparatus incidentally	211	933	102	.....	.....	.....	211	933	102
Total	11,606	48,564	5,969	4,249	20,104	2,674	15,855	68,668	8,643

1916.

Fishermen	108	.....	.....	11	.....	.....	119	.....	.....
Sail and row boats	64	.....	$2,240	3	.....	$195	67	.....	$2,435
Gasoline boats	2	.....	225	1	.....	350	3	.....	575
Gill nets	76	.....	2,937	3	.....	480	79	.....	3,417
Seines	3	.....	350	.....	.....	.....	3	.....	350
Shore and accessory property	.....	.....	528	.....	.....	540	.....	.....	1,068
Total	.....	.....	6,280	.....	.....	1,565	.....	.....	7,845
Shad caught:									
With gill nets	7,536	31,670	4,399	1,500	7,250	925	9,036	38,920	5,324
With seines	191	1,008	99	.....	.....	.....	191	1,008	99
With other apparatus incidentally	60	245	42	.....	.....	.....	60	245	42
Total	7,787	32,923	4,540	1,500	7,250	925	9,287	40,173	5,465

[a] Includes Albany, Columbia, Dutchess, Green, Orange, Rennselaer, Rockland, Schuyler, Ulster, and Weschester Counties in New York, and Bergen and Hudson Counties in New Jersey.

NEW ENGLAND VESSEL FISHERIES.

Statistics of the extensive offshore vessel fisheries centering at Boston and Gloucester, Mass., have been collected during the year by the local agents, and published in monthly and annual bulletins showing, by species and fishing grounds, the quantities and values of the fishery products landed by the American fishing vessels at these ports.

The fleet in 1915 was composed of 410 sail, steam, and gasoline screw vessels. These vessels landed at Boston 3,772 trips, aggregating

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97,899,487 pounds of fish, valued at $2,911,314, and at Gloucester 3,472 trips, aggregating 73,696,241 pounds, valued at $1,826,603. The total for the two ports was 7,244 trips, aggregating 171,595,728 pounds of fresh and salted fish, having a value to the fishermen of $4,737,917. Compared with the previous year there was a decrease of 354 trips, but an increased production amounting to 9,006,508 pounds in quantity and $342,887 in value. There was a small decrease in the catch of cod, but an increase in that of practically all the other important species. The value of haddock and cusk was slightly less than that of the previous year. The halibut product increased 491,100 pounds in quantity and $46,946 in value. The mackerel catch increased 6,688,850 pounds, or over 63 per cent, in quantity, and $259,354, or 73 per cent, in value. There was some decrease in the take of Newfoundland herring, but an increase in the value. Swordfish increased 739,123 pounds in quantity and $43,890 in value.

The following tables present in detail (1) by fishing grounds and (2) by months the products of the vessel fisheries of Boston and Gloucester during the calendar year 1915. The weights of fresh and salted fish given in these statistics represent the fish as landed from the vessels, and the values are those received by the fishermen. The grades, or sizes, given for certain species are those recognized in the trade.

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1915, SHOWN BY FISHING GROUNDS.

Fishing grounds.	Number of trips.	Cod.											
		Large (10 pounds and over).				Market (under 10 and over 2½ pounds).				Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
		Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.													
East of 66° west longitude.													
La Have Bank	25	141,030	$5,383			155,543	$3,288			20,000	$261		
Western Bank	36	172,639	5,046			204,735	3,730			20,400	227		
Quereau Bank	2	15,000	400										
Green Bank	1												
Grand Bank	3	4,285	563			4,210	86						
St. Peters Bank	1	3,300	164										
Off Newfoundland	4												
Cape North	1	1,300	36										
Cape Shore	167	415,194	14,881			554,093	11,212			85,393	871		
Gulf of St. Lawrence	5	3,065	121			3,465	89			1,950	22		
St. Anns Bank	2	3,390	102			1,660	33			175	4		
The Gully	1	11,100	461			8,000	187						
Roseway Bank	1	1,000	25										
West of 66° west longitude.													
Browns Bank	282	1,343,950	50,449			2,235,641	45,333			216,774	2,799	695	$14
Georges Bank	507	1,519,392	66,574			2,753,489	64,879			142,071	2,147		
Cashes Bank	33	64,870	3,311			84,660	2,083			8,627	111		
Clark Bank	5	22,295	1,088			60,202	1,368			2,325	21		
Fippenies Bank	10	14,170	755			25,355	626			1,835	23		
Tillies Bank	1	570	48			1,070	43			540	8		
Middle Bank	222	159,055	8,531			208,112	5,666			28,086	423		
Jeffreys Ledge	541	345,375	16,895			457,004	13,147			42,222	712		
Ipswich Bay	50	145,566	5,913			60,260	1,597			3,667	61		
South Channel	516	663,110	40,226			1,883,970	53,989			241,555	3,530		
Nantucket Shoals	62	114,508	5,843			567,113	13,558			47,352	576		
Off Highland Light	9	5,740	355			6,175	235			835	12		
Off Chatham	494	1,365,015	66,469			2,261,528	53,368			226,330	2,758		
Off Race Point	61												
Bay of Fundy	5	7,730	216			13,965	235			340	4		
Seal Island	1	6,830	126			7,045	93			275	2		

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South	4												
Shore, general	720	632,203	23,526			370,919	9,066			19,005	285		
Total	3,772	7,181,682	317,507			11,928,214	283,911			1,109,757	14,857	695	14
LANDED AT GLOUCESTER.													
East of 66° west longitude.													
La Have Bank	28	71,930	1,383	30,195	$1,062	203,399	3,009	52,010	$1,702	11,575	87	12,960	285
Western Bank	58	823,735	15,644	122,871	4,350	1,231,960	18,246	107,185	3,590	47,389	364	16,475	443
Quereau Bank	44	369,297	7,417	993,996	35,608	344,580	5,394	650,111	22,403	10,395	78	96,010	2,410
Green Bank	5	45,430	862	15,020	456	900	13	5,240	180				
Grand Bank	42	348,405	6,882	1,021,825	36,002	14,775	232	358,239	11,707			15,450	392
St. Peters Bank	2			12,950	494			2,920	100				
Sambro Bank	2	13,015	247	100	4	15,285	229	260	8			330	7
Burgeo Bank	2	31,200	583	15,460	661	2,150	32	5,290	189				
Bacalieu Bank	3	5,280	100	62,855	2,190	430	6	9,065	294			475	11
Off Newfoundland	46	18,100	344	1,303,721	46,544	6,350	95	162,905	5,309				
Cape North	1			40,360	1,413			13,265	431			150	5
Cape Shore	30	161,477	3,232	55,621	1,936	211,480	2,984	51,700	1,706	21,915	165	6,405	148
Gulf of St. Lawrence	60	2,493,260	49,286	2,160,188	75,697	1,279,370	22,235	1,466,098	47,640	20,585	255	81,270	2,140
St. Anns Bank	8	218,495	4,183	26,640	932	302,345	4,536	24,540	698	17,720	133	800	18
The Gully	14	165,370	3,218	55,690	2,305	39,887	598	15,900	593	150	6	365	9
Labrador Coast	1			13,120	459			4,855	158				
West of 66° west longitude.													
Browns Bank	70	561,276	11,001	32,665	1,240	891,764	14,037	27,845	937	65,881	504	5,376	117
Georges Bank	161	395,993	8,680	686,464	29,068	1,385,379	23,534	1,007,460	36,037	37,539	296	51,756	1,524
Cashes Bank	8	13,540	266			24,805	393			2,950	22		
Fippenies Bank	1												
Middle Bank	75												
Jeffreys Ledge	5	9,950	199			9,090	146			930	7		
Ipswich Bay	6	103,745	2,075			11,045	177			2,005	15		
South Channel	13	5,130	104			115,330	2,010			5,270	39		
Nantucket Shoals	18	82,445	1,635	21,810	872	68,526	1,085	26,265	920	765	6	720	22
Off Race Point	2												
Bay of Fundy	1	1,000	20			3,980	60						
Shore, general	2,766	1,448,779	53,036	8,374	414	63,080	1,072	3,092	123	10,640	80	4,366	131
Total	3,472	7,386,852	170,397	6,679,925	241,707	6,225,910	100,123	3,994,245	134,725	255,709	2,057	292,908	7,662
Grand total	7,244	14,568,534	487,904	6,679,925	241,707	18,154,124	384,034	3,994,245	134,725	1,365,466	16,914	293,603	7,676

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1915, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Haddock.						Hake.					
	Large (over 2½ pounds).				Scrod (1 to 2½ pounds).		Large (6 pounds and over).				Small (under 6 pounds).	
	Fresh.		Salted.		Fresh.		Fresh.		Salted.		Fresh.	
LANDED AT BOSTON.												
East of 66° west longitude.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
La Have Bank	378,625	$12,403	.....	.....	31,242	$523	33,250	$911	.....	.....	67,710	$958
Western Bank	2,160,230	38,661	.....	.....	179,995	1,815	10,000	200	.....	.....	7,045	133
Grand Bank	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	225	3
St. Peters Bank	.....	.....	.....	.....	.....	.....	2,800	70	.....	.....	.....	.....
Cape North	.....	.....	.....	.....	.....	.....	3,800	49	.....	.....	.....	.....
Cape Shore	1,637,452	45,100	.....	.....	92,330	1,129	94,955	3,540	5,000	$75	118,975	2,426
Gulf of St. Lawrence	76,360	2,512	.....	.....	3,560	38	1,300	52	.....	.....	1,500	25
St. Anns Bank	25,900	616	.....	.....	100	2	2,885	87	.....	.....	1,580	27
The Gully	.....	.....	.....	.....	.....	.....	4,900	245	.....	.....	2,400	96
Roseway Bank	2,675	47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
West of 66° west longitude.												
Browns Bank	7,438,830	201,325	.....	.....	717,381	9,930	265,403	11,126	.....	.....	358,607	8,701
Georges Bank	3,974,542	103,064	.....	.....	1,869,868	36,671	58,612	1,008	.....	.....	41,060	686
Cashes Bank	38,200	957	.....	.....	2,960	36	162,102	4,754	.....	.....	289,979	4,393
Clark Bank	166,495	3,376	.....	.....	36,075	200	300	6	.....	.....	3,850	50
Fippenies Bank	12,040	309	.....	.....	2,675	30	30,065	1,058	.....	.....	42,910	841
Tillies Bank	2,300	58	.....	.....	1,060	11	.....	.....	.....	.....	4,000	48
Middle Bank	849,883	36,111	.....	.....	302,696	6,425	174,522	6,842	.....	.....	553,474	11,384
Jeffreys Ledge	1,587,032	73,835	.....	.....	552,373	12,707	304,100	12,084	.....	.....	1,350,172	27,153
Ipswich Bay	9,327	341	.....	.....	665	6	3,105	76	.....	.....	8,560	128
South Channel	11,464,217	311,271	.....	.....	6,225,145	76,898	564,687	15,590	.....	.....	1,461,593	22,504
Nantucket Shoals	83,175	2,178	.....	.....	21,220	172	18,950	709	.....	.....	26,735	497
Off Highland Light	37,585	1,717	.....	.....	9,115	203	7,640	257	.....	.....	18,030	295
Off Chatham	5,618,771	161,469	.....	.....	1,634,349	16,524	256,365	7,404	.....	.....	750,515	12,215
Bay of Fundy	17,175	569	.....	.....	3,290	39	70,360	1,996	.....	.....	123,645	1,469
Seal Island	6,970	181	.....	.....	800	8	5,360	107	.....	.....	1,980	23
Shore, general	447,312	18,123	.....	.....	117,470	2,697	767,145	24,929	.....	.....	1,585,752	25,899
Total	36,035,096	1,014,223	.....	.....	11,804,369	166,064	2,842,606	93,190	5,000	75	6,820,297	119,954

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LANDED AT GLOUCESTER.												
East of 66° west longitude.												
La Have Bank	230,660	2,408	11,035	$193			964,811	11,530	28,680	453		
Western Bank	987,020	10,189	9,695	183	27,120	184	1,165,560	14,164	45,798	800		
Quereau Bank	108,810	1,091	2,960	52			110,230	1,297	23,633	398		
Green Bank							14,615	183	3,385	60		
Grand Bank			14,075	246			33,975	415	81,640	1,282		
St. Peters Bank							435	5	5,200	91		
Sambro Bank	6,780	71					171,880	2,149				
Burgeo Bank							1,675	17				
Bacalieu Bank									975	17		
Off Newfoundland	100	1					1,135	11				
Cape North			50	1					13,585	238		
Cape Shore	115,250	2,780	5,584	98	520	3	341,890	4,226	29,270	512		
Gulf of St. Lawrence	8,785	91	17,490	352	1,115	20	84,905	937	28,266	474		
St. Anns Bank	12,760	140	30	1			10,730	134	3,375	59		
The Gully	5,230	53					78,240	1,213	7,105	120		
West of 66° west longitude.												
Browns Bank	1,410,412	17,601	5,215	91	12,540	122	506,533	5,849	11,915	207		
Georges Bank	4,835,132	50,480	61,926	1,100	777,965	5,693	69,442	838	2,646	43		
Cashes Bank	12,070	126					244,600	2,467				
Fippenies Bank							13,675	137				
Jeffreys Ledge	1,075	11					78,435	784				
Ipswich Bay	1,725	17					5,885	59				
South Channel	400,245	4,128			235,625	1,639	29,690	367				
Nantucket Shoals	740	8	2,300	40								
Bay of Fundy							46,900	469				
Shore, general	776,216	28,242	234	4	5,690	67	951,171	17,075	10,152	178		
Total	8,913,010	117,437	130,594	2,361	1,060,575	7,728	4,926,412	64,326	295,625	4,932		
Grand total	44,948,106	1,131,660	130,594	2,361	12,864,944	173,792	7,769,018	157,516	300,625	5,007	6,820,297	119,954

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1915, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.												
East of 66° west longitude.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Le Have Bank	17,428	$277			76,088	$1,132			16,647	$1,998		
Western Bank	18,680	419			1,995	29			22,504	2,354		
Quereau Bank									8,338	577		
Green Bank									50,000	3,500		
Grand Bank	555	11							60,000	3,760		
St. Peters Bank									30,000	2,400		
Off Newfoundland									55,000	4,400		
Cape North									35,000	3,150		
Cape Shore	51,987	1,204			155,595	2,222			28,743	3,823		
Gulf of St. Lawrence									160,000	10,400		
St. Anns Bank									47	3		
The Gully	185	3			200	3						
Roseway Bank									231	19		
West of 66° west longitude.												
Browns Bank	334,799	7,051			1,371,140	20,386			191,392	28,372		
Georges Bank	484,521	10,775			71,058	1,011			124,512	16,700		
Cashes Bank	22,490	550			190,171	3,079			2,013	261		
Clark Bank	5,355	104			10,135	130			2,406	354		
Fippenies Bank	6,345	161			49,985	854			420	70		
Tillies Bank	1,350	44			600	4						
Middle Bank	253,397	6,441			180,963	3,345			8,687	1,225		
Jeffreys Ledge	998,231	29,054			479,261	8,541			7,771	1,348		
Ipswich Bay	17,700	415			9,100	165			31	4		
South Channel	498,737	12,101			148,307	2,236			86,963	12,504		
Nantucket Shoals	42,275	825			12,195	215			4,173	448		
Off Highland Light	2,645	66			3,100	53			1,176	114		
Off Chatham	1,224,002	26,972			83,362	1,609			26,394	3,551		
Bay of Fundy	3,470	44			49,965	636			120	25		
Seal Island	955	12			14,720	155			584	57		
Shore, general	299,340	7,204			413,741	7,212			7,242	910		
Total	4,284,447	103,733			3,321,681	53,127			930,409	102,327		

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LANDED AT GLOUCESTER.												
East of 66° west longitude.												
La Have Bank	28,530	267	5,795	$102	539,944	7,563	5,295	$133	80,412	6,544		
Western Bank	58,525	536	3,635	64	462,095	6,764	14,125	353	244,487	19,626	2,525	$152
Quereau Bank	4,461	45	8,193	144	38,449	569	12,050	300	540,334	40,804	20,609	1,405
Green Bank			90	2	390	6	1,040	26	83,115	5,970	114	10
Grand Bank			7,775	136	1,820	28	3,680	91	672,373	52,750	41,035	2,462
St. Peters Bank	110	1			270	4	30	1	6,200	558	20	2
Sambro Bank	3,455	35			57,605	796						
Burgeo Bank					455	7	137	3	95,092	5,545	400	40
Bacalieu Bank							415	10	31,940	1,930	1,945	117
Off Newfoundland					410	7	85	2	65,688	3,201		
Cape North			280	5			2,010	50	2,500	164	510	31
Cape Shore	9,460	89	1,640	29	308,917	4,385	10,925	289	100,424	9,269		
Gulf of St. Lawrence	70	1	26,972	471	15,595	228	930	21	228,504	11,969	116,621	8,575
St. Anns Bank	1,795	18			550	8						
The Gully	2,835	57	255	4	10,212	151	3,075	76	266,516	22,791	275	21
Labrador Coast											102,151	8,673
West of 66° west longitude.												
Browns Bank	58,820	593	1,950	31	864,602	13,196	8,200	206	64,784	4,522		
Georges Bank	151,978	1,500	173,359	2,995	153,170	2,161	31,150	761	171,397	13,817	305	21
Cashes Bank	8,320	75			167,068	2,417						
Fippenies Bank					7,280	116						
Jeffreys Ledge	870	8			91,250	1,458						
Ipswich Bay	1,385	13										
South Channel	4,880	44			530	7						
Nantucket Shoals	2,945	26	2,850	50								
Bay of Fundy	360	3			940	15						
Shore, general	8,338,067	142,144	1,846	37	192,568	2,990	1,796	45				
Total	8,676,866	145,455	234,640	4,070	2,914,120	42,876	94,943	2,347	2,653,766	199,460	286,510	21,509
Grand total	12,961,313	249,188	234,640	4,070	6,235,801	96,003	94,943	2,347	3,584,175	301,787	286,510	21,509

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1915, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Mackerel.											
	Large (over 2½ pounds).				Medium (1½ to 2½ pounds).				Small (under 1½ pounds).			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.												
East of 66° west longitude.												
Cape Shore	258,790	$26,316	104,037	$4,160	269,592	$20,488	37,763	$1,781	281,792	$14,434	20,243	$810
West of 66° west longitude.												
Georges Bank	125,247	14,750	15,000	1,260	228,690	22,514	1,400	181	166,346	8,408	.....	.....
Middle Bank	2,399	503	161	26	5,354	454	833	100	62,568	3,104	210	17
Jeffreys Ledge	1,439	304	.....	.....	1,000	100	.....	.....	5,112	433	.....	.....
Ipswich Bay	.....	.....	.....	.....	1,545	170	.....	.....	8,420	618	.....	.....
South Channel	3,140	675	.....	.....	8,147	996	.....	.....	20,490	808	.....	.....
Nantucket Shoals	7,050	1,274	.....	.....	17,711	1,929	.....	.....	57,790	3,089	.....	.....
Off Chatham	26,531	994	6,000	420	37,811	2,703	36,000	2,460	197,973	10,009	20,000	660
Off Race Point	36,007	2,098	.....	.....	30,123	1,703	.....	.....	574,542	28,882	78,100	1,959
South	11,852	1,422	18,000	856	6,864	961	6,000	285	701	112	.....	.....
Shore, general	166,433	15,515	2,700	113	244,554	20,697	3,600	180	2,463,370	98,885	146,460	7,603
Total	638,888	63,851	145,898	6,835	851,391	72,715	85,596	4,987	3,839,104	168,782	265,013	11,049
LANDED AT GLOUCESTER.												
East of 66° west longitude.												
Cape Shore	.....	.....	624,700	23,958	.....	.....	.....	.....	.....	.....	2,200	88
Gulf of St. Lawrence	.....	.....	22,800	1,980	.....	.....	23,600	2,210	.....	.....	70,000	5,090
West of 66° west longitude.												
Georges Bank	5,100	391	221,700	15,596	7,600	650	.....	.....	.....	.....	.....	.....
Middle Bank	.....	.....	.....	.....	126,865	5,365	21,500	1,505	532,921	25,103	981,200	81,506
Nantucket Shoals	.....	.....	.....	.....	.....	.....	20,600	1,157	6,730	220	125,000	6,801
Off Race Point	.....	.....	.....	.....	.....	.....	2,000	140	13,600	945	.....	.....
Shore, general	51,025	3,479	.....	.....	14,669	782	.....	.....	1,256,681	40,733	962,021	68,161
Total	56,125	3,870	869,200	41,534	149,134	6,797	67,700	5,012	1,809,932	67,001	2,140,421	161,646
Grand total	695,013	67,721	1,015,098	48,369	1,000,525	79,512	153,296	9,999	5,649,036	235,783	2,405,434	172,695

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Fishing grounds.	Miscellaneous.				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
LANDED AT BOSTON.										
East of 66° west longitude.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
La Have Bank	6,796	$464			944,359	$27,598			944,359	$27,598
Western Bank	82,882	8,991			2,881,105	61,605			2,881,105	61,605
Quereau Bank					23,338	977			23,338	977
Green Bank					50,000	3,500			50,000	3,500
Grand Bank	360	31			69,635	4,454			69,635	4,454
St. Peters Bank	508	37			36,608	2,671			36,608	2,671
Off Newfoundland	[a] 600,000	15,900			655,000	20,300			655,000	20,300
Cape North					40,100	3,235			40,100	3,235
Cape Shore	871,924	67,023			4,916,815	214,669	167,043	$6,826	5,083,858	221,495
Gulf of St. Lawrence					251,200	13,259			251,200	13,259
St. Anns Bank					35,737	874			35,737	874
The Gully					26,785	995			26,785	995
Roseway Bank					3,906	91			3,906	91
West of 66° west longitude.										
Browns Bank	188,492	8,670			14,662,409	394,142	695	14	14,663,104	394,156
Georges Bank	1,475,094	142,324			13,034,502	491,661	16,400	1,441	13,050,902	493,102
Cashes Bank	34,858	1,814			900,940	21,349			900,940	21,349
Clark Bank	9,399	235			318,837	6,932			318,837	6,932
Fippenies Bank	6,325	118			192,125	4,845			192,125	4,845
Tillies Bank	650	21			12,140	285			12,140	285
Middle Bank	80,375	1,797			2,869,571	92,251	1,204	143	2,870,775	92,394
Jeffreys Ledge	222,079	5,632			6,353,171	201,945			6,353,171	201,945
Ipswich Bay	1,698	37			269,644	9,531			269,644	9,531
South Channel	1,028,835	34,432			24,298,901	587,760			24,298,901	587,760
Nantucket Shoals	50,361	1,708			1,070,608	33,021			1,070,608	33,021
Off Highland Light	5,483	99			97,524	3,406			97,524	3,406
Off Chatham	465,647	9,310			14,174,593	375,355	62,000	3,540	14,236,593	378,895
Off Race Point	11,949	228			652,621	32,911	78,100	1,959	730,721	34,870
Bay of Fundy	9,300	291			299,360	5,574			299,360	5,574
Seal Island	750	16			46,269	780			46,269	780
South	28,483	1,101			47,900	3,596	24,000	1,141	71,900	4,737
Shore, general	627,096	13,834			8,161,582	268,782	152,760	7,896	8,314,342	276,678
Total	5,809,344	314,113			97,397,285	2,888,354	502,202	22,960	97,899,487	2,911,314

[a] Herring.

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1915, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Miscellaneous.				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
LANDED AT GLOUCESTER.										
East of 66° west longitude.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
La Have Bank					2,131,261	$32,791	145,970	$3,930	2,277,231	$36,721
Western Bank					5,047,891	85,717	322,309	9,935	5,370,200	95,652
Quereau Bank	138	$12			1,526,694	56,707	1,807,562	62,720	3,334,256	119,427
Green Bank					144,450	7,034	24,889	734	169,339	7,768
Grand Bank					1,071,348	60,307	1,543,719	52,318	2,615,067	112,625
St. Peters Bank					7,015	568	21,120	688	28,135	1,256
Sambro Bank					268,020	3,527	690	19	268,710	3,546
Burgeo Bank					130,572	6,184	21,287	893	151,859	7,077
Bacalieu Bank					37,650	2,036	75,730	2,639	113,380	4,675
Off Newfoundland	[a] 1,770,150	53,075	[b] 8,931,550	$186,819	1,861,933	56,734	10,398,261	238,674	12,260,194	295,408
Cape North					2,500	164	70,210	2,174	72,710	2,338
Cape Shore	9,936	696			1,281,269	27,829	788,045	28,744	2,069,314	56,573
Gulf of St. Lawrence					4,132,189	85,022	4,014,235	144,650	8,146,424	229,672
St. Anns Bank					564,395	9,152	55,385	1,708	619,780	10,860
The Gully					568,440	28,087	82,665	3,128	651,105	31,215
Labrador Coast							120,126	9,290	120,126	9,290
West of 66° west longitude.										
Browns Bank					4,436,612	67,425	93,166	2,829	4,529,778	70,254
Georges Bank					7,990,695	108,040	2,236,766	87,145	10,227,461	195,185
Cashes Bank					473,353	5,766			473,353	5,766
Fippenies Bank					20,955	253			20,955	253
Middle Bank	5,250	81			665,036	30,549	1,002,700	83,011	1,667,736	113,560
Jeffreys Ledge					191,600	2,613			191,600	2,613
Ipswich Bay	16,100	64			141,890	2,420			141,890	2,420
South Channel					796,700	8,338			796,700	8,338
Nantucket Shoals					162,151	2,980	199,545	9,862	361,696	12,842
Off Race Point					13,600	945	2,000	140	15,600	1,085
Bay of Fundy					53,180	567			53,180	567
Shore, general	2,847,995	30,824			15,956,581	320,524	991,881	69,093	16,948,462	389,617
Total	4,649,569	84,752	8,931,550	186,819	49,677,980	1,012,279	24,018,261	814,324	73,696,241	1,826,603
Grand total	10,458,913	398,865	8,931,550	186,819	147,075,265	3,900,633	24,520,463	837,284	171,595,728	4,737,917

[a] Herring, 1,768,150 pounds, value $53,045; and caplin, dried, 2,000 pounds, value $30.

[b] Herring, 8,930,800 pounds, value $186,723; and salmon, 750 pounds, value $36. Other items under "Miscellaneous" include bluebacks, 707,970 pounds, value $5,686; butterfish, 316,234 pounds, value $7,370; catfish or wolffish, 179,999 pounds, value $3,197; flounders, 652,172 pounds, value $29,884; herring, 1,977,620 pounds, value $20,381; horse mackerel, 671 pounds, value $27; redfish, 88,694 pounds, value $1,134; shad, 421,701 pounds, value $8,602; sharks, 24,418 pounds, value $246; skates, 114,876 pounds, value $1,429; swordfish, 2,238,967 pounds, value $221,559; tilefish, 28,518 pounds, value $1,102; whiting, or silver hake, 4,800 pounds, value $48; porpoise, 200 pounds, value $3; lobster, 6,000 pounds, value $1,080; turtle, 75 pounds, value $3; livers, 1,153,450 pounds, value $16,088; sounds, 100,685 pounds, value $5,947; spawn, 70,213 pounds, value $6,029; and tongues, 1,500 pounds, value $75.

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1915, SHOWN BY MONTHS.

Months.	Number of trips.	Cod.											
		Large (10 pounds and over).				Market (under 10 and over 2½ pounds).				Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.		*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
January	213	521,945	$18,874	.....	.....	714,205	$14,510	.....	.....	97,582	$1,328	.....	.....
February	213	395,844	19,025	.....	.....	707,559	16,187	.....	.....	67,667	1,068	695	$14
March	276	728,602	31,226	.....	.....	760,754	18,301	.....	.....	78,454	1,184	.....	.....
April	224	704,191	19,101	.....	.....	730,398	12,682	.....	.....	64,495	759	.....	.....
May	233	1,029,582	27,288	.....	.....	1,098,431	19,076	.....	.....	91,000	930	.....	.....
June	318	980,456	44,807	.....	.....	1,728,108	36,084	.....	.....	135,247	1,414	.....	.....
July	425	578,066	30,251	.....	.....	1,391,218	32,322	.....	.....	93,381	1,154	.....	.....
August	400	549,639	31,694	.....	.....	1,504,854	38,797	.....	.....	94,489	1,290	.....	.....
September	388	484,308	28,457	.....	.....	1,198,356	32,746	.....	.....	124,661	1,518	.....	.....
October	477	420,340	27,107	.....	.....	862,061	28,934	.....	.....	92,022	1,574	.....	.....
November	357	372,504	22,557	.....	.....	583,320	18,865	.....	.....	85,864	1,430	.....	.....
December	248	416,205	17,120	.....	.....	648,950	15,407	.....	.....	84,895	1,208	.....	.....
Total	3,772	7,181,682	317,507	.....	.....	11,928,214	283,911	.....	.....	1,109,757	14,857	695	14
LANDED AT GLOUCESTER.													
January	243	370,890	12,160	127,079	$5,316	221,035	3,105	28,660	$1,197	15,725	118	1,625	49
February	127	89,351	4,131	24,170	915	35,475	591	7,905	304	4,820	36	240	8
March	412	330,730	11,817	84,729	3,910	121,600	2,047	29,605	1,243	6,420	59	725	22
April	562	1,285,754	28,447	368,255	14,625	866,509	12,798	225,665	7,552	34,859	262	1,905	58
May	292	898,669	18,612	219,985	8,901	755,470	11,666	185,983	6,577	53,904	416	5,282	159
June	225	1,311,015	25,137	1,650,650	58,061	702,025	10,809	1,057,747	34,712	22,070	190	52,099	1,567
July	154	834,553	18,556	1,649,330	58,861	1,007,968	18,582	915,270	30,238	31,965	314	64,380	1,680
August	200	790,938	15,345	563,039	20,227	932,505	15,170	423,443	14,445	27,327	209	31,890	794
September	181	775,313	14,318	759,375	27,441	868,886	14,066	600,773	20,813	25,845	203	97,922	2,449
October	224	259,758	5,978	861,459	30,061	415,107	6,801	411,295	13,931	11,815	93	28,696	664
November	453	254,963	9,799	219,177	7,638	152,285	2,280	25,619	863	14,279	107	2,365	49
December	399	184,918	6,097	152,677	5,751	147,045	2,208	82,280	2,850	6,680	50	5,779	163
Total	3,472	7,386,852	170,397	6,679,925	241,707	6,225,910	100,123	3,994,245	134,725	255,709	2,057	292,908	7,662
Grand total	7,244	14,568,534	487,904	6,679,925	241,707	18,154,124	384,034	3,994,245	134,725	1,365,466	16,914	293,603	7,676
Grounds E. of 66° W. long	595	5,536,297	120,563	5,930,612	210,113	4,584,617	76,234	2,929,583	96,708	257,647	2,473	230,690	5,868
Grounds W. of 66° W. long	6,649	9,032,237	367,341	749,313	31,594	13,569,507	307,800	1,064,662	38,017	1,107,819	14,441	62,913	1,808
Landed at Boston in 1914	3,389	8,019,801	325,323	2,720	122	12,304,351	255,541	1,100	44	1,012,441	14,904	.....	.....
Landed at Gloucester in 1914	4,209	5,843,388	152,554	7,092,272	278,991	8,342,072	165,118	3,953,624	150,288	557,820	4,468	400,036	12,063

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1915, SHOWN BY MONTHS—Continued.

Months.	Haddock.						Hake.					
	Large (over 2½ pounds).				Scrod (1 to 2½ pounds).		Large (6 pounds and over).				Small (under 6 pounds).	
	Fresh.		Salted.		Fresh.		Fresh.		Salted.		Fresh.	
LANDED AT BOSTON.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
January	3,289,737	$101,203	.....	.....	662,212	$13,323	69,795	$2,953	.....	.....	238,924	$5,604
February	4,204,753	141,988	.....	.....	1,083,046	21,292	115,642	6,547	.....	.....	309,065	9,358
March	4,689,670	127,744	.....	.....	910,516	15,101	135,692	7,021	.....	.....	431,213	11,434
April	3,053,352	55,756	.....	.....	395,035	3,634	177,061	5,356	.....	.....	449,185	6,627
May	1,676,049	56,784	.....	.....	565,499	6,067	260,345	5,598	.....	.....	472,700	5,505
June	2,604,526	61,593	.....	.....	851,452	6,294	284,855	8,086	.....	.....	625,030	8,840
July	2,476,960	62,628	.....	.....	710,040	6,083	248,530	7,968	5,000	$75	361,335	5,883
August	3,151,393	62,286	.....	.....	1,164,780	7,610	229,809	7,588	.....	.....	376,601	6,576
September	3,564,508	76,693	.....	.....	1,416,061	11,799	321,068	10,667	.....	.....	522,306	9,612
October	3,535,237	95,248	.....	.....	1,774,698	17,464	592,954	14,292	.....	.....	1,592,295	21,539
November	1,777,816	88,310	.....	.....	1,136,057	28,984	261,947	10,941	.....	.....	907,061	17,320
December	2,011,095	83,990	.....	.....	1,134,973	28,413	144,908	6,173	.....	.....	534,562	11,656
Total	36,035,096	1,014,223	.....	.....	11,804,369	166,064	2,842,606	93,190	5,000	75	6,820,297	119,954
LANDED AT GLOUCESTER.												
January	285,240	8,986	1,180	$25	7,490	41	48,160	1,801	1,785	28	.....	.....
February	204,759	5,471	2,615	45	4,200	62	37,285	1,105	610	9	.....	.....
March	747,808	14,937	1,735	29	20,000	188	54,668	2,095	625	10	.....	.....
April	1,802,934	26,003	2,870	51	10,490	58	253,198	3,051	2,635	45	.....	.....
May	190,297	2,672	11,070	195	.....	.....	593,025	5,930	2,690	48	.....	.....
June	155,500	1,594	18,674	326	55,455	279	535,290	5,354	56,233	971	.....	.....
July	943,435	9,613	41,980	791	165,755	1,094	540,580	5,774	70,008	1,081	.....	.....
August	2,180,675	22,778	26,307	473	277,230	2,097	1,074,576	13,214	50,724	824	.....	.....
September	1,681,430	17,683	11,845	208	406,355	3,057	1,157,675	14,501	48,708	853	.....	.....
October	701,715	7,441	8,990	159	113,600	852	389,602	4,826	37,277	644	.....	.....
November	10,250	108	1,203	22	.....	.....	177,194	4,493	20,080	353	.....	.....
December	8,972	151	2,125	37	.....	.....	65,159	2,182	4,250	66	.....	.....
Total	8,913,010	117,437	130,594	2,361	1,060,575	7,728	4,926,412	64,326	295,625	4,932	.....	.....
Grand total	44,948,106	1,131,660	130,594	2,361	12,864,944	173,792	7,769,018	157,516	300,625	5,007	6,820,297	119,954
Grounds E. of 66° W. long	5,756,637	116,163	60,919	1,126	335,982	3,714	3,133,971	41,435	275,912	4,579	199,435	3,668
Grounds W. of 66° W. long	39,191,469	1,015,497	69,675	1,235	12,528,962	170,078	4,635,047	116,081	24,713	428	6,620,862	116,286
Landed at Boston in 1914	40,984,573	1,089,696	.....	.....	6,235,842	107,211	2,398,923	76,671	.....	.....	5,112,273	92,089
Landed at Gloucester in 1914	10,145,172	179,684	155,522	3,087	233,019	1,478	5,005,412	69,359	222,033	4,218	14,330	166

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Months.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
January	222,014	$5,505	.....	.....	213,707	$3,902	.....	.....	19,683	$4,967	.....	.....
February	143,595	5,199	.....	.....	499,862	8,195	.....	.....	46,330	7,183	.....	.....
March	211,215	5,586	.....	.....	501,277	8,187	.....	.....	109,151	12,647	.....	.....
April	135,746	2,714	.....	.....	285,273	4,078	.....	.....	135,177	13,171	.....	.....
May	229,943	3,567	.....	.....	239,308	3,108	.....	.....	72,318	7,218	.....	.....
June	599,389	10,596	.....	.....	142,677	2,178	.....	.....	239,679	18,509	.....	.....
July	661,652	13,767	.....	.....	102,040	1,678	.....	.....	54,734	6,085	.....	.....
August	671,647	18,398	.....	.....	91,705	1,654	.....	.....	101,307	11,501	.....	.....
September	553,840	18,468	.....	.....	251,139	3,841	.....	.....	61,432	4,795	.....	.....
October	529,300	14,256	.....	.....	284,806	4,693	.....	.....	46,515	6,566	.....	.....
November	188,206	3,406	.....	.....	292,505	5,010	.....	.....	25,363	5,416	.....	.....
December	137,900	2,271	.....	.....	417,382	6,603	.....	.....	18,720	4,269	.....	.....
Total	4,284,447	103,733	.....	.....	3,321,681	53,127	.....	.....	930,409	102,327	.....	.....
LANDED AT GLOUCESTER.												
January	294,600	8,824	4,065	$61	51,325	907	490	$12	79,546	9,027	230	$23
February	74,488	3,199	200	3	38,827	752	450	10	123,820	9,159	20	2
March	284,541	7,032	2,489	38	103,650	1,551	2,760	69	407,347	34,205	455	46
April	373,147	7,782	3,595	63	434,335	6,893	4,962	124	440,169	29,018	65	7
May	583,211	5,607	25,600	458	410,385	6,269	130	3	136,528	11,272	3,818	382
June	129,498	1,276	56,392	987	150,275	2,255	16,036	398	451,662	24,942	98,621	6,232
July	31,610	310	64,040	1,094	278,117	4,000	12,100	302	255,951	19,596	18,685	1,121
August	68,385	616	36,800	643	400,537	5,649	13,113	327	274,850	20,464	5,200	313
September	73,025	730	16,346	292	688,757	9,644	14,575	365	221,931	14,767	56,926	4,680
October	449,235	5,609	15,462	272	318,513	4,413	18,935	452	143,672	13,617	102,151	8,673
November	4,010,630	64,847	616	11	27,674	378	10,775	270	90,880	10,245	339	30
December	2,304,496	39,623	9,035	148	11,725	165	617	15	27,410	3,148	.....	.....
Total	8,676,866	145,455	234,640	4,070	2,914,120	42,876	94,943	2,347	2,653,766	199,460	286,510	21,509
Grand total	12,961,313	249,188	234,640	4,070	6,235,801	96,003	94,943	2,347	3,584,175	301,787	286,510	21,509
Grounds E. of 66° W. long	198,076	2,963	54,635	957	1,670,590	23,902	53,797	1,335	2,884,095	217,505	286,205	21,488
Grounds W. of 66° W. long	12,763,237	246,225	180,005	3,113	4,565,211	72,101	41,146	1,012	700,080	84,282	305	21
Landed at Boston in 1914	4,655,089	90,372	.....	.....	2,668,546	45,970	.....	.....	826,836	88,441	.....	.....
Landed at Gloucester in 1914	7,588,457	105,150	211,177	4,214	3,078,507	53,577	111,637	3,232	2,236,164	157,836	316,585	30,073

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1915, SHOWN BY MONTHS—Continued.

Months.	Mackerel.											
	Large (over 2½ pounds).				Medium (1½ to 2¼ pounds).				Small (under 1½ pounds).			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
May	16,451	$1,771	.....	.....	14,308	$1,540	.....	.....	718	$114	.....	.....
June	302,755	30,028	124,898	$5,155	320,420	22,482	46,996	$2,262	358,565	17,348	20,453	$827
July	199,892	19,313	21,000	1,680	289,855	27,859	38,600	2,725	502,997	25,701	32,400	1,460
August	24,097	2,813	.....	.....	60,650	5,751	.....	.....	1,256,253	38,847	2,800	160
September	9,954	1,217	.....	.....	7,810	750	.....	.....	809,026	35,679	2,800	280
October	35,797	1,962	.....	.....	28,699	1,526	.....	.....	866,313	47,854	206,560	8,322
November	48,228	6,503	.....	.....	103,567	10,006	.....	.....	45,232	3,239	.....	.....
December	1,714	244	.....	.....	26,082	2,801	.....	.....	.....	.....	.....	.....
Total	638,888	63,851	145,898	6,835	851,391	72,715	85,596	4,987	3,839,104	168,782	265,013	11,049
LANDED AT GLOUCESTER.												
May	4,900	245	.....	.....	4,100	254	.....	.....	1,680	134	.....	.....
June	3,930	222	579,800	21,992	.....	.....	.....	.....	137,941	3,709	17,200	845
July	5,280	400	136,800	8,817	7,600	650	19,400	1,070	22,085	725	178,760	9,832
August	.....	.....	129,800	8,745	3,300	165	22,700	1,592	571,882	19,215	317,771	20,175
September	.....	.....	.....	.....	.....	.....	2,000	140	556,498	18,711	467,557	34,464
October	24,040	1,202	.....	.....	134,134	5,728	23,600	2,210	519,846	24,507	910,733	75,474
November	18,005	1,801	22,800	1,980	.....	.....	.....	.....	.....	.....	248,400	20,856
Total	56,125	3,870	869,200	41,534	149,134	6,797	67,700	5,012	1,809,932	67,001	2,140,421	161,646
Grand total	695,013	67,721	1,015,098	48,369	1,000,525	79,512	153,296	9,999	5,649,036	235,783	2,405,434	172,695
Grounds E. of 66° W. long	258,790	26,316	751,537	30,098	269,592	20,488	61,363	3,991	281,792	14,434	92,443	5,988
Grounds W. of 66° W. long	436,223	41,405	263,561	18,271	730,933	59,024	91,933	6,008	5,367,244	221,349	2,312,991	166,707
Landed at Boston in 1914	448,311	45,897	15,200	760	505,967	34,139	.....	.....	2,412,000	92,620	24,000	1,084
Landed at Gloucester in 1914	123,466	6,595	884,800	51,384	167,906	7,910	669,980	54,310	322,745	9,140	1,114,475	50,886

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Months.	Miscellaneous.[a]				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
LANDED AT BOSTON.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
January	529,461	$15,486	.....	.....	6,579,265	$187,655	.....	.....	6,579,265	$187,655
February	329,574	12,117	.....	.....	7,902,937	248,159	695	$14	7,903,632	248,173
March	172,210	5,992	.....	.....	8,728,754	244,423	.....	.....	8,728,754	244,423
April	61,120	1,235	.....	.....	6,191,033	125,113	.....	.....	6,191,033	125,113
May	174,383	2,838	.....	.....	5,941,035	141,404	.....	.....	5,941,035	141,404
June	544,399	31,046	.....	.....	9,717,558	299,305	192,347	8,244	9,909,905	307,549
July	1,200,904	85,702	.....	.....	8,871,604	326,394	97,000	5,940	8,968,604	332,334
August	824,559	61,267	.....	.....	10,101,783	296,072	2,800	160	10,104,583	296,232
September	901,024	54,703	.....	.....	10,225,493	290,945	2,800	280	10,228,293	291,225
October	634,153	30,321	.....	.....	11,295,190	313,336	206,560	8,322	11,501,750	321,658
November	239,604	6,905	.....	.....	6,067,274	228,892	.....	.....	6,067,274	228,892
December	197,953	6,501	.....	.....	5,775,359	186,656	.....	.....	5,775,359	186,656
Total	5,809,344	314,113	.....	.....	97,397,285	2,888,354	502,202	22,960	97,899,487	2,911,314
LANDED AT GLOUCESTER.										
January	1,770,150	53,075	2,495,586	$38,379	3,144,161	98,044	2,660,700	45,090	5,804,861	143,134
February	.....	.....	.....	.....	613,025	24,506	36,210	1,296	649,235	25,802
March	.....	.....	.....	.....	2,076,759	73,931	123,123	5,367	2,199,882	79,298
April	120,000	1,837	.....	.....	5,621,395	116,149	609,952	22,525	6,231,347	138,674
May	543,400	6,332	.....	.....	4,175,509	69,409	454,558	16,723	4,630,127	86,132
June	1,361,730	13,464	1,226	613	5,016,361	89,231	3,604,678	126,704	8,621,039	215,935
July	545,210	4,500	.....	.....	4,670,109	84,114	3,170,753	114,887	7,840,862	199,001
August	244,620	2,050	.....	.....	6,846,825	116,972	1,620,787	68,558	8,467,612	185,530
September	10,638	117	.....	.....	6,466,353	107,797	2,076,027	91,705	8,542,380	199,502
October	18,246	844	.....	.....	3,499,283	81,911	2,418,598	132,540	5,917,881	214,451
November	7,600	587	310,304	6,379	4,763,760	94,645	861,678	38,451	5,625,438	133,096
December	27,975	1,946	6,124,434	141,448	2,784,380	55,570	6,381,197	150,478	9,165,577	206,048
Total	4,649,569	84,752	8,931,550	186,819	49,677,980	1,012,279	24,018,261	814,324	73,696,241	1,826,603
Grand total	10,458,913	398,865	8,931,550	186,819	147,075,265	3,900,633	24,520,463	837,284	171,595,728	4,737,917
Grounds E. of 66° W. long	3,342,694	146,229	8,931,550	186,819	28,710,215	816,087	19,659,246	569,070	48,369,461	1,385,157
Grounds W. of 66° W. long	7,116,219	252,636	.....	.....	118,365,050	3,084,546	4,861,217	268,214	123,226,267	3,352,760
Landed at Boston in 1914	4,646,219	251,003	70,000	2,100	92,231,172	2,609,877	113,020	4,110	92,344,192	2,613,987
Landed at Gloucester in 1914	5,685,365	118,734	5,768,764	106,528	49,343,823	1,031,769	20,901,205	749,274	70,245,028	1,781,043

[a] Includes herring from Newfoundland, 2,368,150 pounds frozen, $68,945, and 8,930,800 pounds salted, $186,783.

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The fish landed at Boston and Gloucester, Mass., by American fishing vessels are taken principally from fishing grounds lying off the coast of the United States. In 1915, 71.78 per cent of the quantity and 70.74 per cent of the value of the catch landed by the American fishing fleet at these ports were obtained from these grounds. Of the remainder, 9.41 per cent of the quantity and 9.70 per cent of the value were taken from fishing banks off the coast of Newfoundland, 18.73 per cent of the quantity and 19.35 per cent of the value from grounds off the Canadian Provinces, and less than 1 per cent of both the quantity and value from the coast of Labrador. Newfoundland herring constituted 6.58 per cent of the quantity and 5.39 per cent of the value of the products landed at these ports during the year. The herring were taken on the treaty coasts of Newfoundland, but cod and other species from that region were obtained chiefly from fishing banks on the high seas. All the fish caught by American fishing vessels off the Canadian Provinces were from offshore fishing grounds. The catch from each of these fishing regions is given in detail in the following table:

QUANTITY AND VALUE OF FISH LANDED BY AMERICAN FISHING VESSELS AT BOSTON AND GLOUCESTER, MASS., IN 1915, FROM GROUNDS OFF THE COAST OF THE UNITED STATES, NEWFOUNDLAND, AND CANADIAN PROVINCES.

Species.	United States.		Newfoundland.[a]		Canadian Provinces.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Cod:								
Fresh	23,695,413	$689,361	484,815	$9,962	9,907,896	$189,529	34,088,124	$888,852
Salted	1,876,888	71,419	3,009,390	105,146	6,081,495	207,543	10,967,773	384,108
Haddock:								
Fresh	51,712,661	1,185,386	100	1	6,100,289	120,065	57,813,050	1,305,452
Salted	69,675	1,235	14,075	246	46,844	880	130,594	2,361
Hake:								
Fresh	11,248,569	232,237	54,860	704	3,285,886	44,529	14,589,315	277,470
Salted	24,713	428	91,200	1,450	184,712	3,129	300,625	5,007
Pollock:								
Fresh	12,762,282	246,213	665	12	198,366	2,963	12,961,313	249,188
Salted	180,005	3,113	7,865	138	46,770	819	234,640	4,070
Cusk:								
Fresh	4,550,491	71,946	3,345	52	1,681,965	24,005	6,235,801	96,003
Salted	41,146	1,012	5,387	133	48,410	1,202	94,943	2,347
Halibut:								
Fresh	699,496	84,225	1,149,408	84,014	1,735,271	133,548	3,584,175	301,787
Salted	305	21	145,665	11,304	140,540	10,184	286,510	21,509
Mackerel:								
Fresh	6,534,400	321,778	.....	.....	810,174	61,238	7,344,574	383,016
Salted	2,668,485	190,986	.....	.....	905,343	40,077	3,573,828	231,063
Herring:								
Fresh	1,977,620	20,381	2,368,150	68,945	.....	.....	4,345,770	89,326
Salted	.....	.....	8,930,800	186,783	.....	.....	8,930,800	186,783
Swordfish:								
Fresh	1,307,317	145,155	868	68	930,782	76,336	2,238,967	221,559
Miscellaneous:								
Fresh	3,830,532	87,084	2,000	30	41,644	866	3,874,176	87,980
Salted	.....	.....	750	36	.....	.....	750	36
Total	123,179,998	3,351,980	16,269,343	469,024	32,146,387	916,913	171,595,728	4,737,917

[a] Includes 17,975 pounds of salted cod, valued at $617, and 102,151 pounds of salted halibut, valued at $8,673, from the Labrador coast.

Cod.—In 1915 there were 33 vessels employed in the salt-bank fishery and 102 in the market fishery landing their fares at Boston and Gloucester. Considerable cod was landed also by vessels operating on shore grounds. There were landed at these ports 45,055,897 pounds of fresh and salted cod, 34,088,124 pounds of the former and 10,967,773 pounds of the latter, valued at $1,272,960, against 47,529,625 pounds in 1914, of which 36,079,873 pounds were fresh and

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11,449,752 pounds salted, valued at $1,359,416. There was, therefore, a decrease in the quantity in 1915, as compared with the previous year, of 1,991,749 pounds in the fresh and 481,979 pounds in the salted cod landed.

Several large fares of cod were caught during the season of 1915. A trip amounting to 359,483 pounds taken on trawl lines was landed at Gloucester in July, and one of the dory hand-line fleet brought in 478,365 pounds in September, this being the largest fare taken since 1909, when the same vessel weighed off 479,433 pounds.

Haddock.—The haddock fishery in 1915 was carried on with about the same success as in the previous year. The quantity of haddock landed was 57,943,644 pounds, valued at $1,307,813, an increase over the previous year of 189,516 pounds in quantity and a decrease of $73,343 in value. The catch of haddock by line trawlers landed at Boston amounted to 30,776,733 pounds, of which 16.57 per cent were "scrod." The greater part of the scrod haddock brought in by line trawlers came from the inshore grounds, the offshore banks supplying a greater proportion of large haddock. On the inshore grounds the amount of scrod haddock taken varied from 18 to 22 per cent of the total catch and on the offshore grounds from 2 to 8 per cent.

Pollock.—The pollock fishery, which in recent years has supported a considerable fleet of small craft employing purse seines as a means of capture, was carried on with greater success than in 1914. The total catch of pollock landed at Boston and Gloucester, including those taken on hand and trawl lines and in gill nets, was 13,195,953 pounds, having a value of $253,258, an increase of 741,230 pounds in quantity and $53,522 in value compared with 1914. As in previous years, most of the pollock landed by purse seiners and gill netters were caught in spring and fall months.

Halibut.—In the last few years the halibut fishery on the Atlantic coast has fluctuated but little. The yield of fresh and salted halibut in 1915 was 3,870,685 pounds, 3,584,175 pounds of the former and 286,510 pounds of the latter, valued at $323,296, an increase of 491,100 pounds and $46,946 over 1914. The largest catches of this species were made on Georges, Browns, La Have, Quereau, Western, and Grand Banks, the last-mentioned bank supplying the greatest amount. The fishery was conducted throughout the year, but the bulk of the catch was taken during the early spring and summer months. The vessels regularly employed in this fishery numbered 33 sail, although many of the cod hand-line and trawl-line fishermen frequently caught halibut in considerable quantities. The usual activity was displayed in this fishery in the spring of 1916. At the end of May the fleet engaged numbered 26 vessels, and a considerable number of fairly large fares were landed.

The otter-trawl fishery.—This method of fishing, as in 1914, was carried on by 12 steamers. With the exception of several trips landed at Portland and an occasional trip disposed of at Gloucester during such times when there was a glut of fresh haddock in the market, the bulk of fish caught by otter trawlers was landed at Boston. The year's catch was 21,116,300 pounds, representing 380 trips, an increase of 8 trips. There were landed from Georges 105 trips, from South Channel 248, Western Bank 26, and Browns Bank 1. As in the previous year, Western Bank was resorted to in March, April, and May, when haddock were less plentiful on Georges and

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in the South Channel than during the winter months. Of the total quantity of fish landed at Boston by this class of vessels, 17,062,732 pounds were haddock, of which 39.28 per cent were "scrod." The great disparity in the landings of small fish by this method as compared with line trawls is confined wholly to haddock, the large and small fish of other species caught by the two methods, such as cod, cusk, and hake, being more equally divided.

On July 20, 1915, the otter trawler *East Hampton* landed at Gloucester 310,000 pounds of fresh fish, most of which were haddock. The largest trip previously brought in was 300,000 pounds, caught by the otter trawler *Long Island*. These were the largest fares ever taken by American otter trawlers.

Mackerel.—The amount of salted mackerel taken in 1915 was 19,691 barrels, exceeding the catch of the previous year by 4,170 barrels. The catch off the New England coast was 15,480 barrels and on the Cape Shore, including a few fares from the Gulf of St. Lawrence, 4,211 barrels, or 750 barrels less than was taken in those regions in 1914. The total catch of fresh mackerel by the fleet was 71,564 barrels, compared with 68,582 barrels the previous season. The number of fresh mackerel taken on the Cape Shore was 781,000, which exceeded the catch of 1914 by over 200,000 fish. In the fall of 1915 several vessels of the seining fleet made phenomenal catches in Massachusetts Bay, one vessel making a stock of $6,548 in three weeks, at which time it was reported that a much larger body of mackerel was on the coast than had been observed for several years.

The mackerel fishery in the spring of 1916 showed a marked improvement over that of 1915, the catch up to May 15 being nearly double the amount recorded the previous season on the same date. Three vessels of the seining fleet stocked over $9,000 each and one $11,246, the last-mentioned stock being $2,361 more than the highest made by a single vessel to the end of May, 1915. There were engaged in the southern mackerel fishery 24 seiners and 58 netters. Fifteen of the latter sailed from Gloucester and 43 from other ports. The number of seiners was one less than in 1915, but there was an increase of 41 netters. A portion of the seining fleet sailed on March 24, but none of the netters sailed until April 25. The first mackerel of the season of 1916, amounting to 7 barrels, were caught on April 5 about 80 miles east by south from Cape Henlopen, or practically in the same locality where the first fish were encountered the previous season. The fish were landed at Lewes, Del., from which place they were shipped to New York by rail. Other small trips were caught in the same region within a few days, but the first fare of any considerable size was landed at New York on April 26, one vessel bringing in 41,800 fish, followed the next day by the arrival of 6 vessels with trips ranging from 6,000 to 40,000 fish. From this time until the middle of May the supply of mackerel in the New York market was about equal to the demand. For the week ended May 3 the amount of fresh mackerel landed was 553,000 in number, mostly large and medium, compared with 268,576 fish last year, which were mostly small. Many of the large mackerel in April sold for 40 cents each. The average price ranged from 12 to 20 cents for large and medium, while tinkers brought from 3 to 6 cents a pound.

On May 31 there were 1,200 mackerel landed at Boston, the first fare of the season. Four vessels of the seining fleet sailed for the

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Cape Shore May 25, and on June 6 the number had increased to 24 sail. The first mackerel of the season from this region were landed at Boston on June 9, the trip consisting of 10,000 large and 35,000 medium fresh mackerel and 170 barrels salted. On June 10 there were 3 other arrivals from the Cape Shore with fares taken off Halifax and Liverpool, the combined catch amounting to 125,000 of mixed fresh mackerel and 230 barrels salted. At that time there were 15 other seiners on the ground, all of which captured schools of mackerel. Mackerel were reported plentiful on the Cape Shore until June 21, and many large trips were taken. The highest stock made by a single vessel in this region was $6,343, which is the largest recorded for one trip in recent years. Fish were also abundant during the month on grounds in the vicinity of No Mans Land, the entire fleet of seiners and netters fishing in that locality doing well.

Swordfish.—This species was more plentiful in 1915 than in the previous year, and 2,238,967 pounds, having a value of $221,559, were landed at Boston and Gloucester, an increase of 739,123 pounds and $43,860 over 1914. There were 42 vessels engaged in the fishery, operating mostly on the more eastern grounds, although some good catches were made on Georges, Nantucket Shoals, and adjacent grounds. On July 20, 17 vessels landed at the Boston Fish Pier 1,126 swordfish that had been taken on Georges. This was probably the greatest number of swordfish ever landed at an American port in one day.

Winter gill-net fishery.—The winter gill-net fishery practically ceased at the end of May. A fleet of 30 vessels was employed at Gloucester during the season, and there were a few vessels that operated out of other ports. Fishing was conducted on the inshore grounds along the New England coast from Cape Ann to Portland. As in previous years, the principal species taken by this method were cod, haddock, and pollock. While the fleet as a whole did not meet with the same degree of success as in some years past, the fishery was an improvement over the previous season. Several good stocks were made, one vessel making $30,000, with a share of $1,500 to each member of the crew. This was probably the highest record ever attained in one season by a vessel engaged in the winter gill-net fishery.

Italian fishing boats.—The number of Italian motor boats fishing out of Boston and landing their catch at that port has increased in the last few years. At the present time there are approximately 200 boats of this class engaged in the shore fisheries, all of which are too small for registration, being under 5 tons, and in consequence their catch is not recorded in the Boston and Gloucester bulletins. These boats take a variety of species and operate several kinds of fishing gear, namely, trawl lines, hand lines, and drag seines.

Some ten years ago the catch of this class of boats consisted largely of flounders, but in the last few years greater efforts have been made to capture other species of ground fish, such as cod, haddock, cusk, hake, etc. Mackerel also have been taken to some extent. In 1915 the Italian catch landed at Boston, and sold through the New England Fish Exchange, was over 3,500,000 pounds of fish, valued at $135,000. The catch consisted largely of cod, haddock, pollock, hake, and cusk. The amount of flounders landed was about 36,000 pounds.

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PACIFIC HALIBUT AND COD FISHERIES.

The halibut banks off Oregon and Washington, recently surveyed by the steamer *Albatross*, were resorted to during the month of June, 1915, by a portion of the halibut fleet sailing out of Seattle, from which grounds 26 trips of halibut were taken in that month, comprising 1,318,000 pounds, valued at $64,623. As halibut were scarce on these grounds in the summer months, the remainder of the catch of that species landed at Seattle from June to December was taken from banks farther north, extending from Flattery Bank, off the coast of Washington, to Portlock Bank, Alaska. This amounted to 13,876,970 pounds, having a market value of $820,585. In the first half of the calendar year 1916, 25 fares were brought from the banks off Oregon and Washington, amounting to 931,692 pounds, valued at $77,819. The total quantity of halibut landed at Seattle during that period, including the catch from banks farther north, was 7,391,384 pounds, valued at $608,947, taken in 274 trips.

According to the Pacific Fisherman, the total catch of halibut on the Pacific coast by American vessels in 1915 was 50,238,390 pounds, of which 33,133,313 pounds were landed at Seattle, 11,323,500 pounds in Canadian ports, and 5,781,577 pounds in Alaska, against 48,902,575 pounds the preceding year, a gain of 1,335,815 pounds. The American fleet engaged in this fishery consisted of 100 sail, known as "independent" and "company" vessels, there being 89 of the former and 11 of the latter, ranging in size from 7 to 196 tons. The Canadian fleet comprised 27 vessels, the catch of which amounted to 16,031,265 pounds, an increase of 1,074,465 pounds over 1914.

The fleet employed in the cod fishery of the Pacific coast numbered 20 sail, including 2 vessels engaged in transporting cured fish from the shore stations in Alaska. Three regions were represented in the fishery—San Francisco by 9 vessels, Puget Sound by 8 vessels, and Alaska by 3 vessels. One of the Alaskan vessels was lost in the early part of the season. The fleet met with very good success and made a catch of 3,798,071 fish, equivalent to 19,092,319 pounds, the fish being reckoned at 4½ pounds each. The catch fell short of that of 1914 by 122,831 fish, or 552,739 pounds.

The work of collecting statistics of the quantity and value of fishery products landed at Seattle, Wash., by American fishing vessels was reestablished in June, 1915, by the appointment of a local agent at that port. The products landed from July, 1915, to June, 1916, comprised 513 trips, including 19,580,163 pounds of halibut, valued at $1,330,609, and 948,024 pounds of other species, valued at $23,285; a total of 20,528,187 pounds, valued at $1,353,894. The monthly receipts by species are shown in the following table:

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT SEATTLE, WASH., BY AMERICAN FISHING VESSELS DURING THE FISCAL YEAR 1916.

Month.	Number of trips.	Halibut.		Cod.		Black cod.	
1915.		*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
July	61	2,700,430	$152,859	.....	.....	39,300	$855
August	36	1,698,288	92,253	645	$10	8,860	217
September	53	2,172,000	132,496	1,312	20	332,000	8,300
October	31	1,644,792	103,952	.....	.....	130,545	3,164
November	30	2,312,527	147,994	.....	.....	17,000	425
December	28	1,660,742	92,108	.....	.....	26,000	650
1916.							
January	8	923,055	68,049	.....	.....	18,000	360
February	7	706,931	47,669	.....	.....	16,232	443
March	31	815,209	82,226	60	1	16,175	484
April	61	1,207,372	130,438	.....	.....	10,566	318
May	89	2,024,105	129,672	.....	.....	84,955	2,124
June	78	1,714,712	150,893	.....	.....	200,233	4,883
Total	513	[a] 19,580,163	1,330,609	2,017	31	899,866	22,223

Month.	Ling cod.		Rock cod.		Total.	
1915.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
July	.....	.....	.....	.....	2,739,730	$153,714
August	.....	.....	1,000	$15	1,708,793	92,495
September	.....	.....	.....	.....	2,505,312	140,816
October	.....	.....	10,000	250	1,785,337	107,366
November	.....	.....	.....	.....	2,329,527	148,419
December	.....	.....	.....	.....	1,686,742	92,758
1916.						
January	.....	.....	.....	.....	941,055	68,409
February	.....	.....	.....	.....	723,163	48,112
March	.....	.....	.....	.....	831,444	82,711
April	6,006	$120	11,413	283	1,235,357	131,169
May	.....	.....	.....	.....	2,109,060	131,796
June	11,732	230	5,990	123	1,932,667	156,129
Total	17,738	350	28,403	681	20,528,187	1,353,894

[a] Includes 5,000 pounds of salt halibut, worth $125, landed in August. The remainder of the catch was sold fresh.

PROMOTION OF AMERICAN CAVIAR.

One of the most valuable of all fishery products is caviar, which is prepared from the roe of sturgeon primarily, but also from that of the paddlefish of the Mississippi Valley, and sometimes, under appropriate descriptive names, from the eggs of carp, whitefish, and other species. The product has always been imported extensively, while it is known that suitable material in this country is often wasted through ignorance of the fishermen as to the methods of preservation to employ. After a suitable investigation of the matter, the Bureau issued an economic circular describing in simple language the methods which may be efficiently employed by any fisherman. The paper had the twofold object of preventing unnecessary waste through ignorance or neglect and of awakening a more effective interest in the protection of the sturgeon and the paddlefish.

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INTRODUCTION OF NEW AQUATIC FOODS.

One of the most useful ways in which the Bureau of Fisheries can serve the fishermen and the general fish-eating public is to make known new sources of aquatic foods and to assist in establishing fisheries and markets therefor. The conspicuous success achieved in the case of the sea mussel has been referred to in previous reports. This excellent, abundant, accessible, cheap, and widely distributed shellfish, formerly neglected, has now become a staple in certain important markets. Various other water products of great prospective value, but now largely unutilized, should be exploited as speedily as possible, but the limited funds and facilities at the disposal of the Bureau for such work make it impossible to conduct an active campaign with more than one or two such articles at one time. In the fiscal year 1916 one hitherto neglected fish has been given a permanent and important place in the fisheries and fish trade by the Bureau's efforts, and a campaign of great prospective consequence has been inaugurated with reference to several others.

In October, 1915, the Bureau undertook to popularize the tilefish in the belief that it is a fish of great prospective food value. Its utilization had been advocated years ago, but the efforts to introduce it were not sufficiently comprehensive or sustained to bring success, and the fish in reality came into some disrepute because of the failures that attended the attempts to give it a commercial status. The task confronting the Bureau was to induce fishermen to catch the fish, dealers to handle the fish, and the public to consume the fish, and to bring all this about simultaneously. The effective methods pursued made it possible for the Government to withdraw from the campaign within one month and to intrust future developments to private enterprise.

The essential feature of the exploit was the chartering of a regular fishing vessel with practical fishermen as its crew. The auxiliary schooner *Stranger*, of Gloucester, carrying 12 men, was the vessel selected for the purpose. The Bureau had guaranteed the *Stranger* $1,500 for one month's service, but in 27 days she caught 38,383 pounds of tilefish, which, after deducting commissions, sold for $2,036.63; and not only was the Bureau at no expense whatever for the fishing operations, but the proceeds, taking no account of several thousand pounds gratuitously distributed for advertising purposes, yielded a substantial bonus to the crew over their regular remuneration.

When the wholesale trade of New York was requested to cooperate in the proposed campaign, the unfortunate past stood in the way of immediate acquiescence. "There is no demand for the fish," said the dealers, but the Bureau explained that getting the fish and creating a demand were its part of the work and that all that was desired of the trade was a cheerful willingness to handle the fish to satisfy such demand as might develop. When the first fare was landed in New York on October 22, four or five dealers in Fulton Market rather reluctantly agreed to handle the fish, some of which were given away and the remainder sold for 5 cents per pound. When the fourth trip arrived but 20 days later, 15 dealers were competing for the fish, which sold for 7 cents. In the interval a demand had arisen which no large wholesale or commission house could afford to ignore. This demand was created solely by an advertising campaign which kept the fish constantly be-

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fore the public and concentrated attention on its points of interest and excellence. Newspapers were furnished items recounting the unusual history of the fish—its discovery, practical extermination, and reappearance; incidents in the campaign were exploited; fish were more or less conspicuously supplied to prominent persons; leading hotels and restaurants were induced to give the tilefish prominence on their menus; a great motion-picture company placed a camera man on the *Stranger* and exhibited motion pictures of the fishery as a feature of its weekly news reel; and the Bureau's own advertising matter was distributed freely.

The propaganda conducted in behalf of this fishery covered practically the entire field. The fishing grounds were found and pointed out to fishermen; a regular commercial fishing vessel was engaged to demonstrate the financial yield of this fishery under regular industrial conditions; the wholesale trade was enlisted in the distribution of the fish; the retailer was furnished with attractive display advertising matter calling his customers' attention to the fact that the fish was on sale; and the consumer was told about the tilefish and how to cook it, and his curiosity and interest were stimulated to the point where he wished to try it and asked his dealer for it. As a consequence, when the Bureau ceased its fishing operations, other vessels were already at work, and within 10 days of the landing of the last fare by the *Stranger* eight schooners were either in the fishery or about to enter it and by the end of the month had landed in New York about 156,000 pounds of tilefish.

The progress of this fishery has far exceeded expectations. While New York continues to be the center of the industry, Boston, Atlantic City, Newport, and other places have become practically interested by putting vessels in the fishery. At the end of June, 1916, the New York fleet consisted of 13 vessels making regular trips to the fishing grounds, although earlier in the season a number of other vessels were engaged. The catch has varied from month to month, but has shown a general upward trend as increased fares were brought in to meet the growing demand, and the yield in June exceeded that of any preceding month, aggregating over 1,221,000 pounds landed at New York in 28 fares. A new record was made in July, 1916, when 2,200,000 pounds were landed at New York, 230,000 at Boston, and various minor fares at other ports.

By the end of the fiscal year 1916, when the fishery was only eight months old, upward of 4,388,500 pounds of tilefish, which brought the fishermen over $210,000, were caught and sold. The monthly receipts at New York were as follows:

Months.	Pounds.	Months.	Pounds.
November, 1915	156,500	April, 1916	626,000
December, 1915	170,200	May, 1916	620,000
January, 1916	398,000	June, 1916	1,221,000
February, 1916	469,000		
March, 1916	615,000	Total	4,275,700

The tilefish grounds extend along the edge of the continental shelf from a point south of Nantucket to an area east of Atlantic City. Few fish have been taken in depths over 100 fathoms, and the best

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fish are in from 60 to 65 fathoms of water. Tilefish are not particular as to the kind and quality of bait offered them. While squid, bluebacks, menhaden, clams, etc., are very acceptable, they will bite freely on inferior kinds of bait, making the bait question comparatively easy to solve.

The fishery has proved a great deal more remunerative than was at first expected by most fishermen and is now considered by them as being well established. The prices received by the fishermen have at times been as high as 7 cents a pound and as low as 1½ cents, the average being about 5 cents. The fish bears shipment perhaps better than any other staple fish of the Atlantic coast and now reaches consumers all over the eastern half of the country. Some large shipments have gone as far west as Kansas City. The catch in recent months has been at the rate of 20,000,000 pounds per annum.

Following long consideration and much discussion, the present Congress has passed an act, approved June 21, 1916, which provides a way of alleviating the losses sustained by the fishermen, more especially those of the Atlantic coast, from the ravages of dogfishes. The act carries an appropriation of $25,000 to enable the Commissioner of Fisheries to conduct investigations and experiments to this end, and the method of procedure, as recommended by the Bureau and understood by Congress, is to make the dogfishes useful. Mistaken economic and biological conceptions as to the possibility of bringing about the extermination of dogfishes have been abandoned, and all persons now interested in the welfare of the fishermen and the advancement of the fisheries are united in the efforts that will be made, under authority of law, to convert an injurious and hitherto useless article into a valuable asset. While the dogfishes and other sharks yield by-products, such as oil, gelatin, and leather, of undoubted economic importance, their principal utility comes through their known value as food. The task before the Bureau is to overcome the deep-seated prejudice that exists against these fishes and to determine the ways and means for creating a demand for fresh and preserved dogfish that will react on the fishermen and enable them to market their catch at a profit.

ALASKA FISHERIES SERVICE.

EXTENT OF THE ALASKAN FISHERIES.

The enormous fishing industry in Alaska over which the Bureau exercises administrative jurisdiction was in some respects more extensive in the calendar year 1915 than ever before. The number of persons engaged in all branches was 22,462, an increase of more than 1,200 over 1914; the investment was $37,316,560, an increase of upward of a quarter of a million dollars over the previous year; and the value of the output as placed on the market was $20,999,343, a decrease of nearly a quarter of a million dollars compared with 1914, which year registered the highest value attained by the industry. The quantity of fishery products taken in 1915 was greater than in any previous season, but lower prices prevailed for several grades of salmon taken in large numbers.

The salmons continue to overshadow all other fishes in Alaska, and the industry they support represents 86 per cent of the capital

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invested and nearly 80 per cent of the persons employed, while the salmon output is worth more than 91 per cent of the total value of all fisheries. The salient features of the salmon industry in 1915 were the extraordinary abundance of humpbacks in southeast Alaska, the large run of cohos in central and west Alaska, the lighter run of redfish in west and southeast Alaska, and the increased abundance in central Alaska. The value of all salmons as prepared for sale was $19,214,145, of which $18,653,015 represented canned fish. The number of salmon taken was 63,537,244, of which 30,896,394 were humpbacks and 25,878,811 were redfish. The canned-salmon pack was the largest in the history of the Territory, amounting to 4,500,293 cases of 48 1-pound cans, an increase of 443,640 cases over 1914, which was the previous record. The canneries operated numbered 85, against 81 in 1914.

Other fishes in the order of importance were the halibut, with an output of $781,011; the cod, valued at $390,199; and the herring, which, as food, fertilizer, and oil, brought $155,579. The products of the whale fishery were valued at $381,750. The whale fishery was conducted from two shore stations, which handled 470 whales of four species.

ENFORCEMENT OF LAW.

Congress has shown a disposition to provide adequate facilities for enforcing the fishing laws along the extensive Alaskan littoral, but the need for more men and boats is great, and satisfactory results can not be accomplished until the need is met. The available vessel service in 1915 was supplemented by the charter of power boats during the active fishing season, and the patrol covered upward of 10,000 miles of coast.

It is a pleasure to be able to state that the fishery laws are now more generally observed in both spirit and letter than was the case a few years ago, and comparatively few violations were reported in 1915. These are noted in full in the special report on "Alaska fisheries and fur industries in 1915," which forms an appendix to the report of the Commissioner of Fisheries for that year. Some convictions have been secured, some defendants have been discharged, and some indictments are still pending. In one case, involving fishing during the Sunday close time, the defendant pleaded guilty and the jury found him not guilty.

WATERS CLOSED TO COMMERCIAL FISHING.

On October 1, 1915, a hearing was held in Seattle to give all persons interested an oportunity to present their views on the desirability of closing to commercial fishing certain waters in southeast Alaska to be preserved for natural salmon breeding. The hearing confirmed the view that the waters should be closed, and, accordingly, on the recommendation of the Bureau, the Secretary issued an order, dated October 25, 1915, and effective January 1, 1916, prohibiting all fishing for salmon or for other fishes if salmon are taken or injured thereby in the following waters:

1. All waters tributary to Barnes Lake, Prince of Wales Island.
2. Hetta Creek, its tributary waters, and the region within 500 yards of the mouth of said creek.

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3. Sockeye Creek, its tributary Boca de Quadra hatchery waters, and the region within 500 yards of the mouth of said creek.

COMMERCIAL FISHING WITHIN RESERVATIONS.

Permits have been issued by the Department, on the recommendation of the Bureau, to conduct certain fishing operations within the limits of the Aleutian Islands Reservation, established by executive order of March 3, 1913. In January, 1916, the company known as the Pacific-American Fisheries was authorized to construct and operate on Unalaska Island a plant for canning or salting salmon or other food fishes. This is the first permit of this character granted, as former permits have covered only minor fishing. The matter of granting a permit for a cannery within the reservation came about as the result of a petition signed by 109 natives of Unalaska Island, who set forth that the construction of a cannery on Unalaska Island would afford them a most advantageous means of employment and at the same time the operations of the cannery would not make such a heavy demand upon the runs of salmon that there would not be enough left for the food requirements of the natives. The permit was granted under the condition that all work except that requiring skilled mechanics and operators in connection with the taking of fish and their subsequent preparation for market should be performed by the Aleuts or Indians resident upon the said reservation. Other conditions were that the weekly close season should be observed, that fishing would not be conducted with fixed appliances, and that no fishing would be carried on within any salmon stream or within 100 yards outside of the mouth of any such stream. Failure to observe the stipulations of the permit will automatically result in its termination. The permit is not transferable and is revocable at any time at the pleasure of the Secretary of Commerce.

In January, 1916, a private individual of Unalaska was authorized to conduct certain specified fishing within the reservation, with a stipulation as to the employment of native help. In June, 1916, the Union Fish Co., of San Francisco, was granted permission to engage in cod-fishing operations from Tigalda Island.

On the Afognak Reservation 79 licenses were issued to natives to take salmon for commercial purposes under restrictions imposed by the Department. The catch, which was disposed of to a cannery located outside the reservation, comprised 134,692 salmon of the red, coho, and humpback species and yielded the natives about $4,500.

By the terms of a presidential proclamation issued April 28, 1916, the waters within 3,000 feet of Annette Island and several small adjacent islands in southeast Alaska were set apart as a fishing reserve for the exclusive benefit of Alaskan natives living thereon, to be used by them under the fishery laws and regulations of the Territory as administered by the Department of Commerce.

SALMON CENSUS IN WOOD RIVER.

The Wood River has been closed to fishing for many years and is resorted to for breeding purposes by red salmon escaping the nets in Nushagak Bay. The counting of the salmon was first undertaken in 1908 and has been continued annually since that time except in 1914.

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The counting is made possible by throwing a rack across the stream and compelling the fish to pass through a narrow gate where they are easily visible to persons immediately above. Agents of the Bureau in relays are kept on duty day and night for the entire period of the run, and the tally is kept by an automatic counting device manipulated by hand. In 1915 the counting began on June 14, when 161 fish passed, and continued till August 2, when the run had dwindled to 70. The maximum was reached in the seven days from July 7 to 13, 26,901 fish being observed on July 7 and 25,554 on July 12. The total count was 259,341 redfish.

It was noted that many of the fish bore scars, abrasions, and mutilations produced by gill nets from which they had managed to escape. The number of netted fish usually ranged from 12 to 26 per hundred and sometimes from 30 to 42 per hundred, averaging about 18 per cent of those specially enumerated. On the other hand, in one count of 1,103 fish there were only 2 injured. It is estimated that fully 90 per cent of the fish that liberated themselves from the gill nets died before spawning as a result of the injuries received.

As on previous occasions, the Bureau was rendered invaluable assistance in conducting this interesting work by the Alaska Packers Association and the Alaska-Portland Packers Association.

INSPECTION OF HATCHERIES.

The five private salmon hatcheries operated in Alaska in 1915 were inspected from time to time by agents of the Bureau. Cognizance was taken of the number of eggs received and hatched, the number of fry planted, and the hatchery records and methods.

The output of these plants in the fiscal year ending June 30, 1916, was 79,619,500 red-salmon fry. Under the law the operators were entitled to a tax rebate of 40 cents for every thousand fry hatched and liberated; and affidavits having been made in the manner prescribed by law, the operators became entitled to receive rebate certificates aggregating $31,847.80, which amount is applied to the tax of 4 cents per case on canned salmon.

In June, 1916, a communication was received from the Alaska Packers Association announcing that, in view of certain unfavorable conditions at the hatchery belonging to that company at Karluk, it had been decided to close the plant at the end of the fiscal year 1916 or as soon as the fry then on hand could be liberated. This is the oldest hatchery in Alaska, having been built in 1896. During the period of its operation, which was continuous, it has handled over 627,000,000 red-salmon eggs.

ALASKA FISHERY LEGISLATION.

The necessity for revising the present fishery laws of Alaska has been appreciated for some years. The matter took definite shape in January, 1916, when Hon. J. W. Alexander, of Missouri, introduced in the House of Representatives a bill for the protection, regulation, and conservation of the fisheries of Alaska. The bill was referred to the Committee on the Merchant Marine and Fisheries, of which he was chairman, and numerous hearings thereon were held during the latter part of the fiscal year. The bill has the approval of the Department, was prepared after protracted conferences with repre-

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sentatives of the fishing industry, and is designed to meet the new conditions that have arisen since the law of June 26, 1906, was passed. It is believed that the essential features of the bill, if enacted into law, will insure the perpetuation of the Alaskan fisheries at their maximum productivity and will yield to Federal and Territorial Governments a handsome revenue. Up to the close of the fiscal year the measure had not been acted on by the committee, but this was subsequently done, and a favorable report was ordered on a revised bill introduced by Mr. Alexander on August 18.

The halibut fishery, which ranks next to the salmon industry in importance and is capable of still further expansion, is reported to be injuriously affected as an Alaskan industry by the unusual course followed by the Canadian Government for the promotion of the interests of the Grand Trunk Pacific Railroad and its western terminus, Prince Rupert. The matter has had the attention of the Department of Commerce, in cooperation with other executive departments, and the decision has been reached that legislative action is required to prevent the diversion of the Alaskan halibut fishery, whose output goes only to the American market, from Alaska to British Columbia. The Bureau has, therefore, approved a measure, introduced in Congress, which is intended to meet the peculiar geographic and economic conditions surrounding the fishery. Under the terms of the proposed bill, fresh halibut (and salmon) from the Pacific Ocean and its tributaries coming into the United States through a foreign country must be shipped in bond from an American port.

On June 3, 1916, the Senate passed a bill for the protection and conservation of the halibut fishery of the Pacific Ocean, which includes the establishment of a close season for halibut fishing in certain waters and places restrictions on the landing of halibut during that time. The chief feature of the bill is the fixing of a close season during the months of December and January, when all fishing for halibut in any of the waters of the Pacific Ocean or its tributaries over which the United States has jurisdiction is prohibited. The bill also provides for a reserved area off the coast of southeast Alaska, in which fishing for halibut is prohibited at all times. This area is defined definitely in the bill, but, briefly, it may be described as a rectangular area of water about 19 miles long and averaging 15 miles in width extending offshore between Cape Lynch and Cape Addington. Its area is approximately 290 square nautical miles. The bill provides that it shall take effect as soon as possible after the enactment of concurrent or essentially similar regulations by Canada, and that if at any time after due investigation it is the opinion of the Secretary of Commerce that the regulations adopted by Canada are inadequate either as to their provisions or enforcement he is authorized and directed to suspend the operations of the act until such time as he may be satisfied that such provisions and their enforcement have been made adequate for the protection of the halibut fishery. Violations of the measure are punishable by a fine not exceeding $1,000 or by imprisonment for not more than 90 days. Vessels and their catch may be seized and held subject to the payment of fines. This bill embodies the Bureau's views, and its passage will, it is believed, meet with general favor alike with the American and Canadian halibut fishing interests, which have advocated most of the principles set forth in the bill.

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ALASKA FUR-SEAL SERVICE.

SEAL HERD.

The fur seals resorting to the Pribilof Islands, having enjoyed continued immunity from indiscriminate killing at sea through the operation of an international agreement, have increased in a manner that has justified optimistic predictions.

The regular census of the herd taken in 1915, under the direction of G. Dallas Hanna, showed a noteworthy increase over 1914. The actual number of pups born was 103,527, as compared with 93,250 in 1914, 92,269 in 1913, and 81,984 in 1912. The total number of seals computed to be in the herd was 363,872, as compared with 294,687 in 1914, 268,305 in 1913, and 215,738 in 1912. The classes of seals which are susceptible of actual enumeration are pups, harem bulls, and idle bulls. The number of breeding cows, since each gives birth to but one pup a season, is, of course, equal to the number of pups. The numbers of animals in the remaining classes must be obtained from estimates of death rates, fortified by incomplete counts, etc. In 1915, in view of the increased knowledge of the herd, the enumerator felt it desirable to change the percentages heretofore used in estimating the losses for the first three years of the seal's life. This makes the total of the number of seals determined to be in the herd of 1915 not exactly comparable with the totals of previous censuses. The details of the 1915 count are as follows:

Pups	103,527	3-year-old males	18,282
Breeding cows	103,527	4-year-old males	15,848
Harem bulls	2,151	5-year-old males	11,271
Idle bulls	673		
Yearlings	60,613	Total	363,872
2-year-olds	47,980		

In 1912, 5,228 pups of the season were branded on the Pribilof Islands. Subsequent observations made on these branded animals have been productive of valuable additional knowledge in regard to the natural history and growth of the seals. Some of these animals were observed in 1913, and in 1914 they were noted in large numbers. The number which returned in 1915 was so large, in comparison with the total number of seals under observation, as to indicate a lower mortality in the first three years of the seal's life than had ordinarily been assumed. In 1915, from January 1 to August 10, inclusive, 53 of these branded seals were killed on St. Paul Island and 49 on St. George Island, the skins of which were shipped to St. Louis that year. One hundred of these were graded in accordance with the London trade classification, with the following result:

Small pups	7
Middling pups	42
Large pups	42
Smalls	8
Middling and smalls	1
Total	100

At the same time the skins of 15 of 18 branded seals killed in 1914, and therefore 2 years old, were graded as follows, the remaining 3 not being accessible at the time:

Extra small pups	3
Small pups	8
Middling pups	4

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The census for 1916, taken under the same conditions as in 1915 and with the same basis for computing the various elements of the herd, gave a total of 417,329, as follows:

Pups	116,977	Yearlings, both sexes	67,291
Breeding cows	116,977	2-year-olds, both sexes	48,460
Harem bulls	3,500	Bachelors and young bulls	61,492
Idle bulls	2,632		

These figures indicate a large surplus of male seals, as was to have been expected from the operation of the existing close-time law, which restricts the killing of seals to the limited needs of the natives. The conditions, biological and economic, arising from the presence of large numbers of mature and adolescent males far beyond the requirements of the herd, demand the serious attention of the Department and of Congress, and the conditions will be much more acute by the expiration of the close-time law in August, 1917.

SEALS TAKEN FOR NATIVES' FOOD.

The killing of seals on the Pribilof Islands has been limited to that number necessary for the food purposes of the natives. In the calendar year 1915 the quota of surplus male seals that could be taken was fixed at 5,500. The number actually taken was 2,666 on St. Paul and 1,281 on St. George, a total of 3,947. For 1916 the maximum number that could be taken was fixed at 7,500. Improved facilities for caring for seal meat make it possible for the natives to properly utilize a larger number of seals than formerly, and a saving will, therefore, be effected in the amount of meats that would otherwise have to be sent from the States.

The sealskins shipped from the islands in 1915 numbered 3,000, which were consigned to St. Louis for sale. No skins were disposed of during the past fiscal year. The condition of the market did not warrant the offering of the skins on hand resulting from the food killings for natives in 1914 and previously, and trade considerations made it desirable to postpone beyond the fiscal year 1916 the marketing of those pelts and the additional ones shipped to St. Louis in the fall of 1915. Congress passed a joint resolution, approved June 22, 1916, giving to the Secretary of Commerce authority to dispose of sealskins in such market, at such times, and in such manner as he may deem most advantageous, and the sale was, accordingly, postponed until the fall of 1916.

ESTABLISHMENT OF THE FUR-SEAL TRADE IN AMERICA.

The announced purpose of the Department to market its Alaskan fur-seal and other skins in America, instead of sending them abroad as heretofore, was given definite form in 1915 by the making of a contract with Messrs. Funsten Bros. & Co., of St. Louis, under which the sale of fur-seal and fox skins belonging to the Government will for a term of years take place at public auction in St. Louis. In connection with this contract, the Department has been instrumental in securing the establishment in St. Louis, through Messrs. Funsten Bros. & Co., of a plant for the dressing and dyeing of sealskins in accordance with the most approved methods known to the trade, and arrangements have been made under which all or part of the

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take of Alaskan fur-seal skins may be dressed and dyed before being offered for sale. The actual treatment of fur-seal skins for this purpose was begun in St. Louis in December, 1915, and the results obtained indicate that the work will be highly successful. A limited offering of such skins was made at the public auction held in St. Louis in September, 1916, and the Department has reason to be pleased with the outcome. The interests of the trade and the Government are favored by the offering of dressed instead of raw skins, and general satisfaction has been expressed over this important innovation.

SUPPORT OF THE NATIVES.

The native inhabitants of the Pribilof Islands on June 30, 1915, numbered 314, of whom 193 were on St. Paul and 121 on St. George. The population remains fairly uniform from year to year.

The physical condition of these people is excellent, all things considered. Improved sanitary measures have been enforced, and the promiscuous making and use of intoxicating liquors, once prevalent and sanctioned by the Government, has been entirely suppressed. Congress has recently provided new housing facilities, which, with additional improvements that are contemplated, will conduce still further to the comfort, contentment, and advancement of the natives.

The teaching staff on the islands has performed efficient service, and the native schools are in a satisfactory condition. Stress is being laid on manual training and on the use of the English language instead of Aleut or Russian.

Owing to the delay in making the steamer *Roosevelt* available for carrying supplies to the islands other arrangements had to be made, a navy collier being availed of in the fall of 1915 and a private vessel in the summer of 1916. The very satisfactory and economical method of purchasing supplies, as mentioned in last year's report, has been followed.

In 1911 small numbers of reindeer were placed on both St. Paul and St. George Islands to serve as a nucleus for herds which would contribute materially to the support and welfare of the natives. The herds have thrived and have shown satisfactory increases from year to year. In 1915 the number of fawns born was 45 and the total number of all ages was 154. The natives, however, have not thus far shown the interest in the reindeer that was hoped for, and it will probably be necessary for the Bureau's officers on the islands to direct most of the activities in respect to these herds for a number of years to come. Early in 1916 comprehensive plans were prepared in connection with this work. These plans, in addition to the management of the herd itself, contemplate that the inhabitants of the islands shall be trained to make economic use of the skins, horns, and other parts by manufacturing them into articles of clothing and household furnishings for local use and perhaps export for sale for the natives' benefit.

BLUE FOXES.

The herds of blue foxes which inhabit the Pribilof Islands continue productive of revenue to the natives and the Government. The taking of foxes in the season of 1915-16 was begun in November on

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St. George Island and early in December on St. Paul Island. The take for the season consisted of 211 blue-fox pelts and 18 white-fox pelts on St. Paul Island and 209 blues and 2 whites on St. George Island, a total for both islands of 420 blues and 20 whites. These skins were consigned to Messrs. Funsten Bros. & Co., St. Louis, for sale in September, 1916. In the calendar year 1915 there were shipped from the Pribilof Islands 253 blue-fox skins and 40 white-fox skins. These skins represented the take for the 1914–15 season and, together with 256 blue-fox skins and 25 white-fox skins shipped from the islands in 1914, were sold at public auction on October 21, 1915. The net proceeds of this sale amounted to over $56,000. The sale was very successful and many pelts brought unusually good prices. Five lots consisting of four blues each brought $1,092, $1,020, $1,012, $1,000, and $980, respectively. The white-fox pelts brought from $17 to $30 per pelt.

The number of foxes that the island will support under existing conditions is limited, and the trapping of a certain number each season, under the strict supervision of the agents, is beneficial to the herd. The natives are credited with supplies valued at $5 for each fox skin taken.

COAST-GUARD PATROL AND THE NAVAL RADIO SERVICE.

The usual efficient patrol of the North Pacific Ocean and Bering Sea was maintained by the Coast Guard Service in the seasons of 1915 and 1916 for the purpose of preventing pelagic sealing. The vessels of this patrol rendered invaluable assistance in carrying persons, mails, and supplies, to and from the Pribilof Islands. The agent on St. Paul Island in 1915 reported some evidences of illegal seal hunting, but no proof of such operations could be obtained.

The North Pacific Sealing Convention of July 7, 1911, and the act of Congress giving effect to that convention, approved August 24, 1912, permit certain Indians, Aleuts, or other aborigines dwelling on the Pacific coast of America north of latitude 30° to kill seals under certain restricted conditions. As far as is known, no seals were taken in accordance with these provisions in 1915. In 1916 several hundred skins were taken by Indians of the State of Washington, but complete details in regard to these skins are not yet available. By far the larger proportion of the seals so killed are females.

The Department is under obligations to the Navy Department for the continuous service which the latter has rendered in connection with the two radio stations on the islands. These stations make it possible to keep in prompt touch with conditions on the islands at all times of the year and permit the agents to send full reports of conditions and needs. Formerly the islands were cut off from communication with the entire world through the long winter season, when navigation in Bering Sea is closed.

MINOR FUR-BEARING ANIMALS OF ALASKA.

The laws and regulations for the protection of the minor fur-bearing animals of Alaska have been enforced by a corps of wardens, who have been constantly in the field, supplemented by members of the Alaska fishery service at such times as their regular duties would

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permit. In October, 1915, Reginald F. Irwin, a warden, while engaged in patrol work in southeast Alaska, lost his life. Accompanied by two men in a hired boat he left Ketchikan on October 9, and several days later his wrecked boat was discovered in the Chickamin River. Prolonged and systematic search was at once instituted, but no trace of Mr. Irwin and his companions was found and no explanation of the disaster has been possible.

Under date of May 24, 1915, revised regulations for the protection of fur-bearing animals in Alaska were issued in Department Circular No. 246, third edition. These have proved generally satisfactory. No special restrictions are put upon the shipping of live fur-bearing animals from Alaska or upon the taking of live animals at any time for use for breeding purposes. The law does not clearly authorize the Department to make the necessary regulations restricting the shipping of live animals from the Territory; and owing, apparently, to the decreased outside demand for fur-bearing animals for use for breeding purposes, particularly foxes, but few were shipped from Alaska in the calendar year 1915. This cessation of demand for live Alaska fur bearers may be only temporary, and it is very important that the Department have authority to make proper regulations in regard to the exportation of these animals. It is felt that legitimate fur farmers should be permitted to secure breeding animals from wild stock in the close season, at least until breeding stock may be obtained from other farms. The inability to regulate this matter results in abuses which meet with disapproval throughout Alaska.

The marked decrease in the abundance of martens has necessitated further measures for their protection. The Department has, therefore, issued a regulation, effective March 15, 1916, making the killing of this valuable animal illegal until November 15, 1921. This regulation has met with general approval from persons familiar with the facts. It is covered in Department Circular No. 246, fourth edition, issued under date of February 1, 1916.

The value of the furs shipped from Alaska in the year ended November 15, 1915, exclusive of Pribilof Islands skins, aggregated $400,532. All shipments are required to be reported to the Bureau, and the returns are believed to be quite complete, owing to the effective cooperation given by postmasters, agents of commercial companies, and individual shippers.

In the fiscal year 1916 no additional islands were leased for the breeding of fur-bearing animals. The islands now under lease are Carlson, Middleton, Simeonof, and Little Koniuji. Shortly after the close of the fiscal year there was accepted an offer for the leasing of Marmot Island, near Afognak, for a period of five years at an annual rental of $200.

It is regretted that Congress has not yet taken action to relieve the Bureau of custody over the terrestrial fur bearers of Alaska. A bill to accomplish this purpose was introduced in the House on January 29, 1916, and referred to the Committee on Territories. No hearings have been held thereon, but it is strongly urged that prompt steps be taken to terminate the existing arrangement.

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MISCELLANEOUS MATTERS.

NEW ESTABLISHMENTS AND CONSTRUCTIONS.

The site for the fish-cultural station in Utah authorized in 1914 was selected near Springville, and title to 24.3 acres of land was acquired by deed dated August 24, 1915, together with rights to 15 second-feet of water so disposed as to furnish a gravity supply. Springville is in Utah County on the Denver & Rio Grande Railroad, and the property immediately adjoins the town, being about 1 mile distant from the business center. Water is obtained from springs which flow about 5,000 gallons per minute. A topographical survey of the property has been made; plans of buildings, water supply, and drainage systems have been prepared; and construction work has been begun. The hatchery is a one-story frame structure, built on a cement foundation, and contains hatching room, office, storeroom, boiler room, etc., on the first floor and two bedrooms and workroom in the attic. The building is 32 by 95 feet and is intended to accommodate 120 troughs.

The site selected for the marine biological station on the Gulf coast of Florida was acquired by a deed dated July 10, 1915. It is about 3 miles distant from the city of Key West at the extreme eastern end of the island. The act authorizing the establishment of this station required that the land be donated, and the Key West Realty Co., from which the property was obtained, not only donated 4 acres of land, but, without cost to the Government, constructed a sea wall along the water front of the property and excavated a channel 30 feet wide and 6 feet deep from near Cow Key to the selected site. The full amount authorized in the original act, namely, $50,000, has now been provided, and the preparation of plans and specifications for the laboratory building is under way.

The hatchery authorized for Rhode Island will be located on Block Island and will be devoted to the commercial species of that region. The site has been selected and surveyed, but title to the property has not yet been secured.

The special appropriation of $10,000 for the Orangeburg, S. C., station has been used chiefly in making improvements to the water supply and drainage systems and in constructing six brood ponds and six concrete rearing ponds.

The appropriation of $20,000 for the completion of the Louisville, Ky., station has been expended in part in improving the extensive grounds, providing a fish-culturist's cottage, and constructing 20 concrete retaining tanks under cover.

With the sum of $18,000 provided for the Saratoga, Wyo., station, in addition to the amount previously provided, there have been completed the hatchery, superintendent's residence, fish-culturist's cottage, tool house, ice house, one stock pond, six concrete rearing ponds, and concrete distributing cistern and reservoir. A hydraulic ram has been installed and the main water-supply pipe lines have been laid. The hatchery building is 32 by 64 feet and accommodates 36 troughs.

An additional tract of land containing 6½ acres, adjoining the Cold Spring, Ga., station, was acquired by deed dated July 24, 1915, for the sum of $5,000. The property includes a dwelling, which has been repaired and is utilized to good advantage, and the possession of this

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land enables the Bureau to protect the water supply and construct additional ponds.

At the Clackamas, Oreg., station, a one-story six-room frame building, with attic and cellar, has been completed as a superintendent's residence.

The special appropriation of $4,500 for reconstruction of the hatchery building and barn at the Baker Lake, Wash., station, which were destroyed by fire, has been expended in accordance with the terms of the appropriation. Substantial new buildings constructed by the station force were completed early in the summer of 1915 and were ready for the salmon operations that year.

It is a pleasure to record the donation of a fish hatchery by a private individual. Mary A. Scully, widow of John S. Scully, has transferred to the Government the property known as the Berkshire Trout Hatchery, in the Berkshire Hills, Mass., comprising about 135 acres of land, with buildings, ponds, etc. The hatchery was run for a number of years by Mr. Scully, and Mrs. Scully's object in making this noteworthy bequest was to insure the perpetual maintenance of the property for the purpose to which her husband had dedicated it. The acceptance of the gift was authorized by joint resolution of Congress approved July 28, and the property has now passed into the custody of the Bureau of Fisheries. The necessary permanent personnel has been provided for in the 1918 estimates submitted to Congress.

MOVEMENTS, REPAIR, AND CONSTRUCTION OF VESSELS.

The special fishery and other work with which certain vessels have been connected has been noted elsewhere. There may be given under this head some data that pertain more particularly to the mere movements and the repairs of some of the seagoing craft.

On July 1, 1915, the *Albatross* was being prepared to take up again the halibut investigations off the coasts of Washington and Oregon, and on July 6 the vessel sailed from Sausalito, Cal., arriving off the mouth of the Columbia River July 9. The work was continued until September 9, and the ship then proceeded to San Francisco, arriving two days later. Until October 11 she was anchored off Sausalito and was then taken to docks at Alameda. From that time until March 7, 1916, the crew was kept busy overhauling the ship and machinery, repainting, etc. The vessel was docked on March 7. This long period of inactivity was owing to lack of funds sufficient for cruising expenses. The deficiency act approved February 28, 1916, appropriated $7,500 for maintenance of vessels for the Bureau, and with this sum an investigation of the tuna fisheries off the coasts of southern and lower California was undertaken, an investigation which had been in contemplation for a number of years. The cruise was begun April 4, and the work was in progress at the close of the fiscal year. During the year the *Albatross* cruised some six months, covering 9,850 miles and consuming 950 tons of coal. On July 1, 1915, Lieut. L. B. Porterfield, U. S. Navy, was detached from the command of the vessel and was succeeded on the same day by Lieut. Commander J. J. Hannigan, U. S. Navy.

During the early part of the summer of 1915 the steamer *Fish Hawk* was utilized in connection with the Beaufort laboratory and on August 10 was assigned to special investigations in Long Island Sound, with which she was occupied until October 7. On October 21 the biolog-

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ical and physical investigation of the waters of Chesapeake Bay was undertaken and arrangements were made for periodical trips, five of which were made prior to July 1. Between March 21 and April 15, 1916, the vessel was used in experimental shad hatching on the Cape Fear River. Some minor repairs were made at the Norfolk Navy Yard during November and December, 1915. During the year the vessel cruised 5,811 miles and consumed 703 tons of coal. On September 6, 1915, Boatswain James J. O'Brien, U. S. Navy, was succeeded in command by Chief Boatswain James Mahoney, U. S. Navy.

The *Phalarope* has been attached to the Woods Hole station, as heretofore, and has rendered service in both fish-cultural and biological work at that place. When the shad-hatching season began on the Potomac River in the spring of 1916, the vessel was detailed to that field.

The *Curlew* has been employed on the Mississippi River, in connection with the rescue of fishes from the overflowed lands and with the operations of the Fairport laboratory.

The steamer *Osprey* has been employed in southeast Alaska on fishery-patrol work.

The auxiliary schooner *Grampus*, having headquarters at Gloucester, Mass., was used in oceanographic and herring investigations in the Gulf of Maine from July 1 to October 27, 1915. From November to May the vessel was laid up and her crew was assigned to fish-cultural work at the Gloucester hatchery. From May 9 to June 30 the vessel was at Gloucester, with the crew engaged in scraping, painting, overhauling rigging, and general cleaning, in preparation for cruising after the new fiscal year began.

The alterations originally contemplated on the steamer *Roosevelt* proceeded satisfactorily and were completed at the Norfolk Navy Yard. The vessel was inspected by a board, of which the superintendent of naval construction, Bureau of Lighthouses, was the senior member, and on April 5 this board advised certain additional work before the ship was sent to sea. This was authorized as soon as funds permitted, and all was practically completed in August, 1916, except for the installation of a new tail shaft, a forging for which was difficult to obtain owing to the excessive demands on the steel mills for material. The *Roosevelt* has cost the Government somewhat over $72,000. The original cost of this vessel was about $150,000, and it is estimated that it would have cost not less than $100,000 to build a vessel of similar dimensions which would fill the Bureau's requirements.

A contract for the construction of a new vessel for use on the Maine coast, for which there was an appropriation of $45,000, was awarded, in March, 1916, to the Townsend Marine Railway & Construction Co., of Boothbay Harbor, Me., for $44,217. The vessel was designed for use not only in connection with the operations of the marine hatchery but for oceanographic and fishery investigations as well. She is a single-screw steam-propelled wooden vessel, 108 feet 6 inches over all, with 22 feet beam and 8 feet draft. She is equipped with a 320-horsepower engine and an Almy water-tube boiler, with a mast fitted for dredging. On the main deck are quarters for the officers and investigators, with laboratory and cabin. Below decks are the crew's quarters, water tanks, machinery, storerooms, etc., and an arrangement for transporting live fishes. It is expected the vessel will be completed during the coming winter.

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PUBLICATIONS.

During the fiscal year the following publications were issued and distributed, chiefly through the Superintendent of Documents, on special mailing lists:

REPORT OF THE COMMISSIONER AND APPENDIXES THERETO.

Report of the Commissioner of Fisheries to the Secretary of Commerce for the fiscal year ended June 30, 1915. 83 p.

Alaska fisheries and fur industries in 1914. By Ward T. Bower and Henry D. Aller. Appendix IX to Report of Commissioner for 1914. 89 p.

The distribution of fish and fish eggs during the fiscal year 1915. Appendix I to Report of Commissioner for 1915. 138 p.

Fish ponds on farms. By Robert S. Johnson and M. F. Stapleton. Appendix II to Report of Commissioner for 1915. 28 p., 18 pl.

BULLETIN OF THE BUREAU OF FISHERIES.

An ecological reconnoissance of the fishes of Douglas Lake, Cheboygan County, Mich., in midsummer. By Jacob Reighard. Bulletin, vol. XXXIII, 1913, p. 215–250, 4 text fig. 1915.

The Potamogetons in relation to pond culture. By Emmeline Moore. Bulletin, vol. XXXIII, 1913, p. 251–292, pl. XXII–XXXIX.

Changes in shade, color, and patterns in fishes, and their bearing on the problems of adaptation and behavior, with especial reference to the flounders Paralichthys and Ancylopsetta. By S. O. Mast. Bulletin, vol. XXXIV, 1914, p. 173–238, pl. XIX–XXXVII, 3 text fig.

The sharks and rays of Beaufort, N. C. By Lewis Radcliffe. Bulletin, vol. XXXIV, 1914, p. 239–284, pl. XXXVIII–XLIX, 26 text fig.

Copepod parasites of fresh-water fishes and their economic relations to mussel glochidia. By Charles Branch Wilson. Bulletin, vol. XXXIV, 1914, p. 331–374, pl. LX–LXXIV.

The fishes of the streams tributary to Tomales Bay, Cal. By John Otterbein Snyder. Bulletin, vol. XXXIV, 1914, p. 375–382, 1 text fig.

The Fairport fisheries biological station: Its equipment, organization, and functions. By Robert E. Coker. Bulletin, vol. XXXIV, 1914, p. 383–406, 6 text fig., pl. LXXV–LXXXI.

Notes on the embryology and larval development of five species of teleostean fishes. By Albert Kuntz. Bulletin, vol. XXXIV, p. 407–429, 68 text fig.

SPECIAL PUBLICATIONS.

The Bureau of Fisheries and its station at Woods Hole, Mass. 11 p., illus.

The Bureau of Fisheries and its biological station at Beaufort, N. C. 11 p., illus.

ECONOMIC CIRCULARS.

Fishes destructive to the eggs and larvæ of mosquitoes. 19 p., 28 text fig.

Oysters: The food that has not "gone up". A little of their history and how to cook them. 16 p.

The tilefish: A new deep-sea food fish. 6 p., 2 text fig.

Caviar: What it is and how to prepare it. 8 p., 3 text fig.

Information concerning parasitic worms in fish. 4 p.

STATISTICAL BULLETINS.

Monthly and annual statements of the quantities and values of certain fishery products landed by American fishing vessels at the ports of Gloucester and Boston, Mass., Portland, Me., and Seattle, Wash.

Crab industry of Maryland and Virginia in 1915.

Fresh-water mussel fishery of the Mississippi River and its western tributaries from Kansas northward in 1914.

Coastal fisheries of New York and New Jersey, exclusive of shellfish, in 1915, with shad fishery of the Hudson River in 1915 and 1916.

Shad and alewife industry of Chesapeake Bay and tributaries in 1915.

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The Fisheries Service Bulletin has proved of great interest throughout the Bureau and also to State fishery authorities, technical publications, etc. In order to meet the demand the monthly editions have had to be enlarged from time to time, and the number of pages has been increased from four to eight.

APPROPRIATIONS.

The appropriations for the Bureau of Fisheries for the fiscal year 1916 aggregated $1,075,340, as follows:

Salaries	$393,840
Miscellaneous expenses:	
Administration	10,000
Propagation of food fishes	350,000
Maintenance of vessels	60,000
Inquiry respecting food fishes	40,000
Statistical inquiry	7,500
Protecting sponge fisheries	2,500
Protecting seal and salmon fisheries of Alaska	75,000
Pay of crew of vessel, Alaska service	16,000
Purchase or construction of vessels for Boothbay Harbor station	45,000
Purchase or construction of a steel distribution car	20,000
Cold-storage plant fur-seal islands	3,000
Completion of and improvements at fish-cultural stations:	
Orangeburg, S. C.	10,000
Louisville, Ky	20,000
Saratoga, Wyo	18,000
Baker Lake, Wash	4,500

Respectfully,

H. M. SMITH,
Commissioner.

To Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

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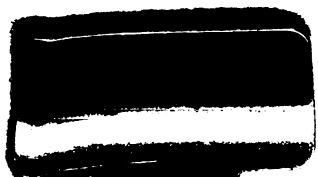

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